

Feasibility of servitization

Transforming fashion value chains to circularity through service innovation

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Executive summary

In recent years the increased awareness of the need for conservation of resources and environmental sustainability has brought a focus on the potential for a circular economy in textiles and fashion. Commissioned by the Region of Västra Götaland, a number of investigations were carried out during 2015-2019, related to redesign, reuse and recycling of textile materials and products, at the Swedish School of Textiles and Science Park Borås. These projects addressed measures and strategies that were considered essential for this purpose, i.e. collection and sorting, design for longevity and recyclability, remanufacturing, and a possible shift of selling offers from products to services and service systems, throughout with an aim to assess the feasibility of each such approach, technically and economically. The findings were consequently presented in a series of five reports, which are collected in this publication. It comprises the following titles:

1. Planning a Swedish Collection and Sorting Plant for Used Textiles – a feasibility study; and, as an annex, Collection and Legislation for Used Textiles and Clothing (commissioned by TEKO)
2. Feasibility of Conditional Design - organizing a circular textile value chain by design principles
3. Feasibility of Fashion Remanufacturing - organizing fashion value chains for circularity through remanufacturing (including redesign)
4. **Feasibility of Servitization - transforming fashion value chains to circularity through service innovation**

The objectives of the reports, where feasibility is a keyword, is to develop structures for circular processes in the textile industry, in order to create new business opportunities and use less planetary resources. The focus is to design for longevity, through conditional design, redesign and remanufacturing and service innovation, and to ensure that the resulting circular processes are technically, organizationally and economically feasible.

Planning a Swedish Collection and Sorting Plant for Used Textiles – a feasibility study

In the first report, the feasibility of collection and sorting of used textiles is assessed. The assessment was based on a model for the different flow directions in collection and sorting – collection by charity organizations, stores, municipalities etc. or directly from users, and sorting into export channels, second-hand stores, recycling and redesign facilities or even destruction by incineration. It was evident that realistic conditions, at that time (2015) at least, did not permit a profitable, fully commercial sorting facility. There was a need for further value-adding features, which must be developed in order to ensure the feasibility of such a centralized facility. Critical success factors, as proposed, are the following.

Voluntary and subsidized work is essential for economic feasibility, and must be supported by legislation, occupational measures or general practice. 2. Increased prime quality in incoming material will raise the income level of sold fractions. There are ways to achieve this, of which one is to convince consumers of providing less used material for collection – perhaps at the cost of shorter first-hand use. Another possibility is a sharing agreement with the charities, which carry out the first-tier sorting. It involves also measures to enable consumers to make more educated decisions. A certification system may also be helpful to achieve better quality. New actors should be encouraged to join the market. 3. Increased productivity in the sorting centre. 4. Increased value of output can otherwise be achieved by innovative sorting,

cleaning, redesign and remanufacturing methods and development of new products. 5. Automated sorting may become increasingly appealing, as new sensors and devices for image-processing, identification, robotics and affordable control units become available. Technology development is needed regarding inexpensive sensors for identifying toxic additives in textiles and for fibre contents. 6. New business models, for example streamlined selling/purchasing by agents, who also provide training, packing etc., web services for used textiles brokerage, or financial recalculation of sustainability values, may become established. 7. Provision of parallel technical and administrative services, such as making a test bed available for new development projects, may as well be an opportunity.

Collection and Legislation for Used Textiles and Clothing

In addition to the report on collection and sorting a meta-analysis of the present situation of the used clothing network in six countries is presented in the second report. The analysis for each country comprises the total consumption of clothing, the collection structure, actors and volumes, a map of the reused clothing network, legislation, taxation, and revenue in the value chain.

The presence of large unified sorting centres increases the volume of used textiles in the market. Used textiles collection, in all the countries, is mainly arranged via traditional collection points like charities, textile banks, door-to-door etc. In-store collection and over-the-counter collections has increased collections in recent years. Sorting of the collected items typically takes place in domestic sorting plants with clearly defined sorting criteria. On an average ~10% of the sorted clothes are re-used in the native country of consumption while nearly 80% is exported to Africa and Asia.

Legislation around used clothing has been observed to be either mandatory or voluntary. In France, a mandatory Extended Producer Responsibility (EPR) scheme has been introduced since 2008, while the other countries have a voluntary EPR. However, certain bodies exist, responsible for setting out directives, guidelines and frameworks for their voluntary members. Taxation on used clothes is mainly in the form of VAT, however the charities are mostly exempted. Waste fees for post-consumer textile waste or landfill taxes exist in almost all the six countries.

Feasibility of Conditional Design - organizing a circular textile value chain by design principles

Conditional design is a concept that involves defining systematically the design elements that are relevant to apply in the design process for both longevity and recyclability. The report on conditional design focuses on the feasibility of service innovation, while intending to answer the following issues, having also in mind to maintain or increase the attractiveness of the products: 1) Can the design/construction phase decisively influence the characteristics of the product, so that the prerequisites for circular, sustainable flows will be significantly improved? 2) Which are then the key critical factors? 3) What is the future for different scenarios? 4) What is in that case a feasible way out for the concrete implementation of a strategy that positively affects the entire textile value chain?

It implies several actions, which can be carried out within a relatively short time frame. They include applying design principles of mono-material choices, modular design and redirecting the design of garments as a process that goes on during the life of the product (i.e. incremental design). It is however clear that it will take considerable time to form the conditional design processes into a mainstream principle for large volumes. The development and implementation of such principles will nevertheless have the impact of creating new innovation products and create new interesting business models, resulting in a growing small and local industry sector. Regional assets can be instrumental in the movement towards circularity, such as an educational centre for the implementation of design actions for synthesizing in value chains, development of media and communication addressing design for circularity in consumers' minds, or the establishment of an arena and facilities for realizing new ideas within the sector.

Critical success factors for design in relation to circularity are thus the following, 1) education of designers and design managers in all issues concerning the implications of design in achieving longevity and circularity, 2) development of a classification system covering design conditions for circularity, to enable the identification of the products already at the design phase; the recognition of the products in sorting phases enables automatic sorting for specific recycling processes, 3) further development of sorting (automatic) systems, 4) further R&D activities in all aspects of recycling processes, 5) further development of incremental design approaches and associated business models, aiming at longevity, and 6) development of an arena with the aim to inspire and educate designers to really demonstrate design's power to synthesize, i.e. identify problems – generate ideas – test the ideas – realize the ideas.

Feasibility of Fashion Remanufacturing - organizing fashion value chains for circularity through remanufacturing (including redesign)

Remanufacturing is practiced only at a very small scale in the fashion industry, despite the increasing need for a development towards dematerialization, higher revalue addition, ways to generate a high profit margin, and at the same time create more employment. A net positive environmental impact however, can only be made through remanufacturing at a larger scale. Yet, research investigations on this matter are insufficient, and knowledge of the practices regarding new value chain models, the associated processes and designers' approach to the product development process is still limited.

The report, based on three participatory action projects, aims to investigate how remanufacturing can be made feasible industrially, for sustainable competitiveness in the fashion industry, through detailed observation of a fairly large and successfully operating remanufacturing business. Key decision elements in different fashion remanufacturing value chain models, the associated critical success factors and the feasibility of fashion remanufacturing are addressed here. Three different fashion remanufacturing models were selected and analysed, namely scaled remanufacturing, distributed redesign and PSS (product service system) redesign-as-a-service. The study identifies the key decision making variables in each of these models, the critical success factors and also in connection assessing the feasibility of each model by constructing various scenarios. It is noted that there is currently no certification system or standard for remanufactured fashion products, which challenges their legitimacy.

Critical success factors for scaled fashion remanufacturing comprise the fraction of input materials obtained for remanufacturing (now very small), yield of remanufacturing processes (now low), remanufacturing process costs (now requiring subsidized workforce and zero cost of material), remanufacturing lead times (needing new tools and technologies) and market price of the remanufactured items. The future potential for scaling up fashion remanufacturing is likely dependent on growing from a redesign studio concept towards a mini-factory. To fuel such mini-factory key requirements comprise the supply of good quality material in considerable volume, high productivity and flexible remanufacturing systems and high demand and price propositions for the remanufactured products. Fashion remanufacturers should also consider collaborating with other collecting organizations, e.g. fashion retailers, acquiring more prime material input, creating a branding strategy and identifying 'new' customer segments, creating innovative design ideas, targeting more and innovative sales channels and, in order to synchronize the supply and demand, also extra resources, 'new' technologies (for disassembly, pattern development and cutting, manufacturing), and flexible remanufacturing systems.

The critical success factors for distributed fashion redesign comprise material cost (which may vary widely), material usage, redesign process cost and lead time, and subsidies obtainable. The future potential for establishing distributed fashion redesign is likely dependent on creating a strong inter-connected network of suppliers and value-adders regionally. Educational efforts are needed, also primarily in circular product development and design, circular production processes, and in circular local flows and establishment of collaborative networks.

The critical success factors for PSS redesign-as-a-service are identified as direct process costs, overhead costs, customers' willingness to pay, and PSS lead time. The future potential here is in developing both the technical solution and improving the customer satisfaction in a larger retail setting, for example by direct-to-garment printing or fun features for customers, like artwork, 3D visualizations, customization features, etc.

Feasibility of Servitization - transforming fashion value chains to circularity through service innovation

Servitization is a growing phenomenon to improve resource efficiency, leading to positive effects for the environmental and for society. It stands for the innovation of an organization's capabilities and processes to create mutual value through a shift from selling products to selling product service systems. In this context, product-service systems are one of the most effective instruments to attain a resource-efficient circular economy. It combines design principles, technology considerations, and marketing strategies into a business model for extending the useful life of a garment. In particular, the economic implications and feasibility will be assessed for such a business model, taking into account crucial factors, such as logistics flow, quality factors, key performance indicators (societal, environmental, economic), life-cycle discussions and the required competence-building. Servitization combines design principles, technology considerations, and marketing strategies into a business model for extending the useful life of a garment. This report demonstrates an economic feasibility assessment, by examining two examples of servitization for circularity in the apparel and fashion industry, and outlining potential business models, along with prospects for future research. Core elements for decision-making and the economic implications and feasibility of extending the useful life of a garment through servitization are identified here. Decision variables are typically choice of partnerships and scenarios, related to distribution channels,

cost structures and revenue streams for creating additional value through extended producer responsibility, and how the servitization offer is marketed and communicated to customers. Critical success factors comprise direct service costs, partnership scenarios and the customers' willingness to pay, in the redesign-as-a-service scenario also direct process costs, overhead costs, customers' willingness to pay and PSS lead time.

Borås, 15 December 2019

The authors

Foreword

Re:textile is a research and innovation project lead by Science Park Borås, and funded by Västra Götalandsregionen. The ambition with Re:textile is to develop structures for circular processes in the textile industry. The goal is to create new business opportunities and use less planetary resources. The focus is to design for longevity through the approaches Conditional Design, Redesign and Remanufacturing, and Service Innovation. Re:textile works with in collaboration with companies and organisations through workshops and projects to find new redesign ideas and business models to establish Re:Design Factory, a consortium for realization of redesign and to investigate the feasibility of circular business models in Sweden.

This report will focus the feasibility of service innovation through studying two projects, Re:love carried out in collaboration with Monki, and Houdini Rental, which is a further development of Houdini Sportswear's rental concept.

Special thanks to both Monki and Houdini, who have been accommodating us in conducting the investigation of the feasibility of their servitization strategies, and in supporting with providing information required to realise this study. We would also like to thank ACG Nyström for advising with equipment related questions. In addition, we would like to thank our Textile Management students Sophie-Marie Ertelt, Ecaterina Guzun and Mirja Scott for conducting Case II research.

This report is written in English to cater to a wider readership.

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Abstract

Servitization is a growing phenomenon to improve resource efficiency, leading to positive environmental effects and for the society. In this context, product-service systems are one of the most effective instruments to attain a resource-efficient circular economy. This report entails two case studies regarding the servitization of apparel and fashion for enabling circular economies. It combines design principles, technology considerations, and marketing strategies into a business model for extending the useful life of a garment. In particular, the economic implications and feasibility will be assessed for such a business model, taking into account crucial factors, such as logistics flow considerations, quality factors, key performance indicators (societal, environmental, economic), life-cycle discussions and the required competence-building.

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1. Introduction

1.1 Background and motivation

In 2009, Johan Rockström (Rockström 2009) explained the safe operating space for humanity on planet earth with the concept of nine planetary boundaries, for example climate change, global freshwater, change in land use, and biodiversity loss among others. If humans do not operate within the right parameters, the social foundations that human sustainable development rests on are jeopardised (Raworth 2012; Dearing et al. 2014), and the needs of current generations will not be met “without compromising the ability of future generations to meet their own needs” (UN 1987, p. 37).

The current take-make-dispose model of the textile and fashion industry uses great amounts of resources, with more than 100 million metric tonnes¹ of textile fibres being manufactured every year and affects the environment, society and the industry negatively with impacts that could be unmanageable (Ellen MacArthur Foundation 2017). Most textile fibres are consumed in North America, with 37 kg per capita and year. Western European countries consume 23 kg per capita and year, and African and Middle East countries consumer 5 kg per capita and year². Simultaneously, clothing utilisation worldwide has decreased by 36% in the last 15 years, ending in either landfill or incineration plants (Ellen MacArthur Foundation 2017). The phenomenon of clothing underutilisation is incentivised by the high availability, affordability, as well as the low quality of garments produced in the fast fashion segment. The fast fashion operating model is the industry predominant, characterized by short lifecycle, trend-based designs, frequent replenishment, and large-scale production (Pal 2016).

The major environmental impact from textile products comes from the production stages. As presented on Figure 1 on the following page, a life cycle analysis carried out by Roos et al. (2016) on the most commonly used clothing items. The analysis demonstrated that the stages of an apparel value chain that consume the most water, chemicals, and energy are fibre and fabric manufacturing- Furthermore, one of the most energy-consuming stages is consumer transportation, which is a restraint in the logistic flows to and from the customers, also referred to as the last- and first-mile problem. This addresses the willingness of the customer or user to transport an apparel product to and from service stations or between peers.

Industry-pooled data from the Higg Index, which is a self-assessment tool developed by the Sustainable Apparel Coalition³, show that the apparel and textile industry in general has few processes in place that would help it to reach a state of sustainable development. On the brand environmental benchmark, the industry scores particularly low in manufacturing, packaging, use phase, and end of use⁴. In contrast to environmental sustainability, which is normally measured quantitatively, social sustainability is measured by nationally or internationally agreed minimum standards for human outcome (Dearing et al. 2014). On social benchmarks, the items “contribution to society” and “transparency” have the lowest scores⁴. Social performance is often measured in risk intensity, and Roos et al. (2016) describe wages under 2 USD as one of the most significant social issues followed by child labour and carcinogen exposure.

¹ <https://www.thefiberyear.com/home>

² <http://www.textileworld.com/textile-world/fiber-world/2015/02/man-made-fibers-continue-to-grow>

³ <http://www.apparelcoalition.org>

⁴ <https://higg.org>

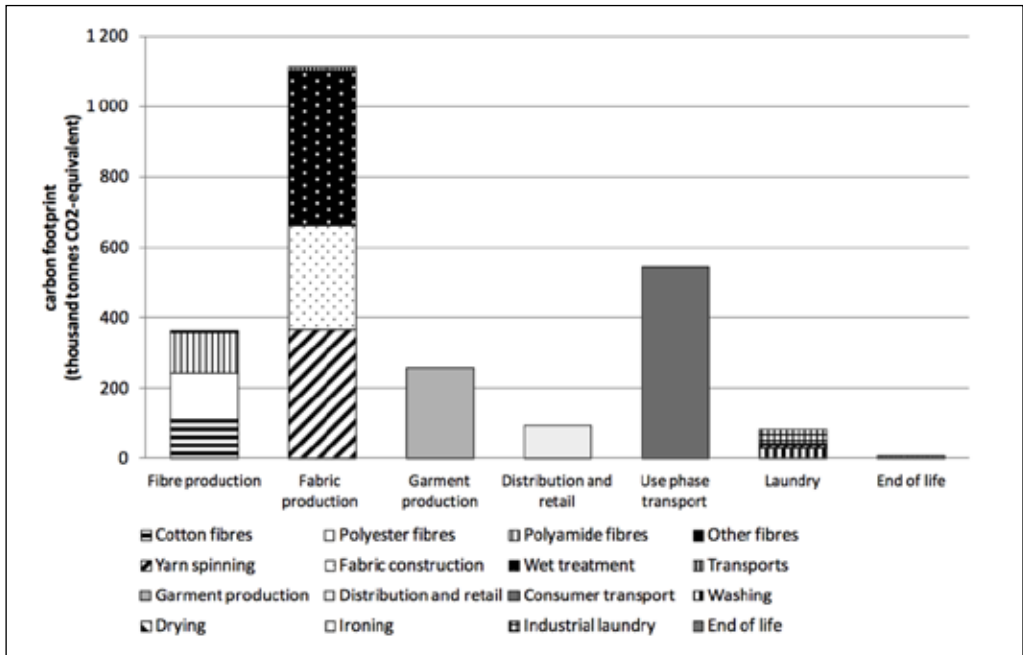


Figure 1. Carbon footprint and scarcity-weighted water use of the Swedish apparel sector over one year (Roos et al. 2016)

To disrupt the linear model, and tackle the issues related to environmental and social sustainability, circular business models, with the goal of developing circular economies, are in focus. Thus, instead of the current linear flows of materials and products, the aim is to keep fibres, textiles and clothes at their highest value during use and re-entering phases (Ellen MacArthur Foundation 2012; 2017). This can be achieved by closing the resource loops by reusing materials through recycling between post-use and production (Bocken et al. 2016). Another option is to slow the resource loops by prolonging the products' lifetime by designing long-life goods and product life extension through services such as repair and remanufacturing (Bocken et al. 2016). The new models for closing and slowing the resource loops lead to the following key actions to access and maintain clothing: (1) the scaling of short-term rental, (2) emphasising the advantages of durability, and (3) further boosting clothing utilisation through policy and Extended Producer Responsibility (EPR) (Ellen MacArthur Foundation 2017).

The aim of such business models is to find ways to generate new revenue streams, based on extending the useful life of an apparel product and to decouple the economic growth from increased outtake of natural resources. This is approached by the concept of servitization of products, processes and firms. Foundational in the study are the six mechanisms of extended responsibility through servitization, some of which are studies in the projects and some that are identified as options for further research: (1) value-adding services for extending physical responsibility; (2) complete product leverage for extending physical responsibility; (3) collaborative partnership for extending financial responsibility; (4) information transparency for extending informative responsibility; (5) raising awareness for extending informative responsibility; and (6) platform-enabled networking for extending informative responsibility (Pal 2016). The mechanisms transfer ownership and risk from the customer to the actors upstre-

am in the value chain (Pal 2016), such as producers and retailers. Creating circularity through servitization in the textile and fashion industry business models addresses the clothing underutilisation.

Information gathered in previous projects, such as Re:Design Lindex, From Roll to Bag, and Digimode, along with two case studies will be analysed for this purpose and as a contribution to estimating the economic feasibility and proposing a business model for service innovation. The business model and the real cost/price relationship are essential for the feasibility of extending the useful life of an apparel product, which may be made of textile fibres, non-woven, various composite materials or leather etc. Foreseen products and services will be described together with identifiable boundary conditions, such as design and construction delimitations and available or near-future technologies for conversion. Market considerations, addressing targets, consumer willingness and societal benefits will also be assessed in this context. To support the discussion, an action research approach will be taken, addressing servitization of mono-material garments, modular and incremental design, functionality and aesthetics for developing structured scenarios for economic feasibility and defining fashion servitization business models.

1.2 Purpose

As described above, in order to reach the sustainable development goals and to operate within the safe space of the planetary boundaries, issues related to the higher impact categories within the value chain of the apparel and industry sector need to be addressed. Thus, in order to attain a resource-efficient circular economy, servitization is in focus by combining design principles, technology considerations, and marketing strategies into a business model for extending the useful life of a garment. Therefore, the purpose of this study is to carry out an economic feasibility assessment by examining two examples of servitization for circularity in the apparel and fashion industry, and outline potential business models, along with prospects for future research, with the three key questions identified:

- a. What are the core elements in different fashion servitization business models for decision-making?
- b. How are the fashion servitization business models perceived by the customers?
- c. What are the economic implications and feasibility to extending a useful life of a garment through servitization?

2. Servitization

According to Baines et al. (2009), servitization can be described as “the innovation of an organization’s capabilities and processes to better create mutual value through a shift from selling products to selling product service systems” (p.555). While servitization has become an integral part of many manufacturing companies in recent years (Baines et al., 2009), it is not surprising that also a fast fashion company like Monki is interested in developing the capabilities needed to provide their customers with services and solutions in addition to their traditional products offerings. Considering that, an additional aspect of servitization according to Mont and Tukker (2006) is that it serves as a way to improve resource efficiency leading to a reduced adverse environmental effect for society. This, as previous research by Tukker and Tischner (2006) points out, makes it a feasible solution for the highly resource inefficient and environmentally stressing global textile-fashion industry (Pal, 2016). Servitization further holds the capabilities to generate a new revenue stream and a competitive advantage

Baines et al. (2009). The servitization process also holds a paradox (Gebauer, Fleisch & Friedli, 2005) in the sense that it is claimed to both increase firm value (Fang, Palmatier & Steenkamp, 2008) as well as decrease profit margins (Neely, 2008). This is why it should not be expected that this research will be able to measure the benefits of employing servitization in profit margins but instead should be seen as a long-term investment towards a potential brand strengthening activity, as well as increased consumer loyalty, making it theoretically a very viable option to increase brand value. Besides, an alternative business model concept employing a form of servitization where used garments are redesigned or upgraded, such as the Monki Re:love case, aims to reduce the dependency on natural resources as well as at the same time strive for improved product longevity (Pal, 2016). This fact gives servitization in this project great potential to accentuate sustainability by, according to Tukker and Tischner (2006), extending the value of tangible products through intangible services.

2.1 Product-service systems

Roy, Shehab and Tiwari (2009) describe product-service systems (PSS) as a tool for a company to enhance its offerings to be able to generate more revenue by better meeting or exceeding customer expectations in a customised way. Moreover, a PSS business model concept allows firms to create new sources of added value to their products and competitiveness to their brand which has the prospect of building unique relationships with its customers, enhancing customer loyalty as well as innovate and react faster to sudden demands of consumers as they follow their customers' needs better (Tukker, Hines & Marin, 2004). All of the above is achieved by designing and combining tangible products and intangible services (Tukker & Tischner, 2006). Pal, Carlsson and Zethraeus (2016) additionally refer to the research of Tukker and Tischner (2006) to emphasize the potential that alternative business models such as renting, redesigning, or upgrading of a company's products aim to reduce the dependency on natural resources, as well as striving for improved product longevity as they extend the value of tangible products. In order to enable a shift towards servitization, the implementation of PSS's requires the combination of new technologies, advanced management, and a better understanding of social systems (Roy, Shehab & Tiwari, 2009).

2.1.1 Types of product-service systems

When employing a servitization strategy, there are several options for the implementation of a PSS Tukker, Hines and Marin (2004). The three main categories can be classified as Product-Oriented Services (PO), Use-Oriented Services (UO) and Result-Oriented Services (RO), all of which have economic and environmental implications (see Figure 2).

The PSS categories are clustered based on how they add value, and where service content stands as opposed to product content on either side of the spectra. In the category of PO the business model stays the same, the focus is to drive product sales with the addition of value adding services. The three sub categories of PO-PSS according to Sakao and Lindahl (2010) are (1) service integration where a new service is added to an existing product; (2) product extension service where the value of a product is increased through an additional service; and (3) vertical integration modified with a focus on delivering strategies to supply products to customers, retailers, and/or customers, who all become directly involved in the production process. UO-PSS opens up for a different business model, where the focus is not on selling products but rather to share, rent or co-own them. RO-PSS requires the furthest step from a traditional business model geared to sell products, and the result is that the primary driver, as well as the product, acts mainly as a tool to reach the result.

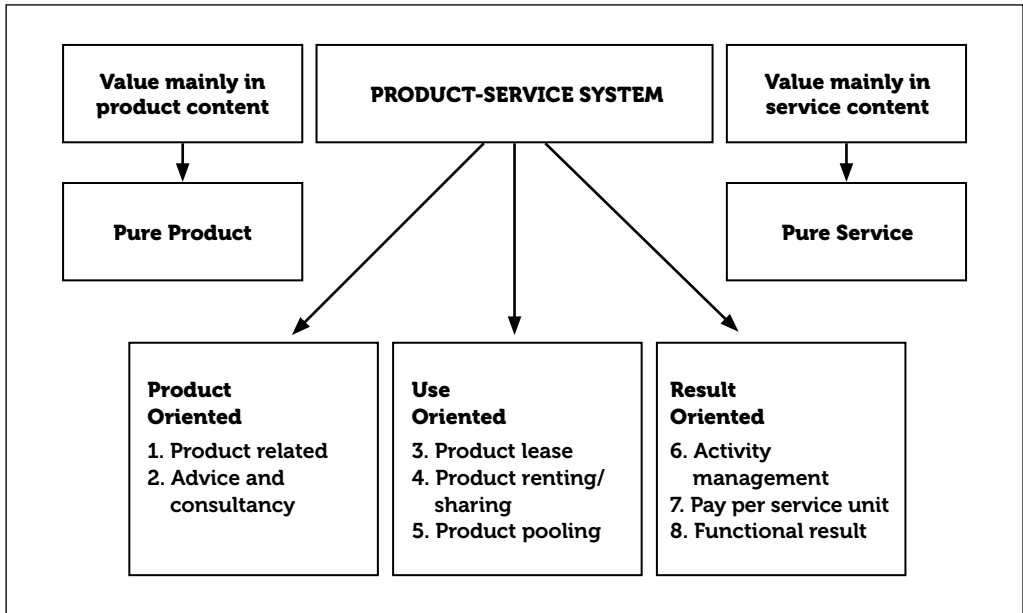


Figure 2. Main and sub-categories of PSS, modified from Tukker, Hines and Marin (2004).

PSS innovations, in general, are concerned with increasing the perceived value offered to customers by providing more benefits through flexible, functional and modular concepts. It is not about product redesign as such, but more about reshaping demand and supply as well as finding radically new ways of meeting the customers' needs more efficiently through unique PSS prepositions (Van Halen, Vezzoli & Wimmer, 2005). PSS business models, such as the initiation with Monki and Re:texture, aims to utilise servitization to add value to already existing fashion products. By developing an in-store PSS implementing mass customisation, customers' needs for new products are met through updating their existing garments through the fast, direct-to-garment printing process enabled by a Brother GTX printer. Such services for redesigning of garments enable the development of long-term and unique relationships with customers (Tukker, Hines & Marin, 2004), and reduce dependency on natural resources Tukker and Tischner (2006).

Rental business models, such as the one offered by Houdini, as alternatives to more traditional sales models allow customers to access garments for one-time occasions and short-term needs without increasing demand for new clothing (Ellen MacArthur Foundation 2017). On the other hand, as highlighted by the foundation, businesses benefit from creating new streams of profit while building long-term relationships with their customers. When it comes to the type of product offered within such collaborative consumption business models, design principles, such as monomateriality and modular design, are relevant to be considered as the design stage determines around 80% of a product's, service's or system's environmental impact (Botsman and Rogers 2010). Furthermore, the authors emphasise the relevance of delivering value in ways that would bring the customer's interest from buying to sharing, while also adapting to customer needs.

2.2 State of the art

This segment showcases examples of how servitization is used in both the textile industry as well as in other industries. In some cases, the types of servitization are applicable across the industries.

2.2.1 Textile industry

NIKEiD

One of the first brands to recognize, and tap into the benefits that stem from allowing their customers to enact the role of a designer by adding a personal touch to a selection of items from the brand's merchandise range, was Nike. The brand's customisation service- NIKEiD⁵ was launched online in 2012, and was part of the brand's Direct To Consumer (DTC) strategy, aiming at increasing margins by selling directly to consumers with made-to-order products. It allows their customers to both fine tune the fit of the shoe as well as expressing their personal style. The customisation process is enabled by the NikeiD product configurator- called NikeiD builder- it both guides the customers through their journey, as well as visualises the iterations made to the products until the desired result is achieved.

NikeiD customisation process emphasizes all four levels of mass customisation as defined by Tseng and Piller (2003). A differentiation level is achieved by offering products that provide utility and suit the consumers' needs the best (Tseng & Piller, 2003). The cost of the customisation is at a level that allows the brand to maintain its market segment (Tseng & Piller, 2003), the cost structure is maintained by both logistic and production efficiency and the consumer's willingness to pay a price premium for the products they build themselves. The relationship level that allows for a higher degree of customer loyalty (Tseng & Piller, 2003) achieved through the collection of information during the customisation process, data that is further used to engage with customers in an increasingly more efficient way.

Take Care

In the beginning of 2018 H&M launched a pilot project in its Hamburg as well as Paris flagship stores with the name "Take Care"⁶, where at an in-store repair station customers are provided with advice, materials and professional services to refurbish, repair and alter used clothing as well as newly purchased items or add custom elements like embroidery to them. Thus H&M, takes advantage of the growing interest of crafting amongst consumers, as well as their willingness to embrace DIY while at the same time addressing the shift in consumer awareness with regards to sustainability (Chiquoine 2018). Customers are able to purchase a range of garment-care products, such as sewing kits, repair patches, stain-removing sprays or environmentally friendly washing detergents. The project aim is to educate customers on how to take better care of their clothing and can be considered part of H&M's wider sustainability aim towards the fashion industry's shift to a circular model.

Tailor Shops

Levi's, the American heritage company and currently the world's leader in jeans⁷, offers a range of services to their customers that support the company's products, and enable a

⁵ https://help-en-us.nike.com/app/answer/a_id/3393

⁶ <https://fashionunited.uk/news/fashion/h-m-launches-take-care-apparel-pilot-in-hamburg/2018-041629128>

⁷ <https://www.levi.com/SE/en/features/about-us>

close consumer-product relationship. Product services include repairs, fit adjustment through tailoring as well as customisation. Levi's created a new retail experience for their customers through Levi's Tailor Shops, offering their customers the opportunity to customise their denim, enabling an increased product/brand emotional connection. The brand emphasizes the importance of the shareable moment, and the role embellishments play in the preservation of a time well spent. In collaboration with denim fashion artists such as Paula Kunkel, music artists, fashion influencers as well as selected customers are invited to customise Levi's jeans assortment. Such collaborations with artists are according to Jean-Noel Kapferer (2015) a very smart way to ensure the artification of a brand as they demonstrate consideration for culture, intelligence and the ability to value artists and their work. Although offering prints as an embellishment option, Levi's are currently not exploring the potential of direct-to-garment printing as a customisation solution.

2.2.2 Non-textile industries

Power-by-the-Hour

A Rolls-Royce trademark, was invented in 1962 to support the Viper engine on the de Havilland/Hawker Siddeley 125 business jet. A complete engine and accessory replacement service was offered on a fixed-cost-per-flying-hour basis. This aligned⁸ the interests of the manufacturer and operator, who only paid for engines that performed well.

Light as a Service

Instead of buying lamps, Philips provides the opportunity to install low energy consumption technology⁹. In the service the current need to lighting is assessed, a lighting plan is created and when in action maintenance and support is guaranteed.

Bundles

Miele offers users to rent instead of investing in washing machines and other laundry equipment. Normally, quality machines would be a large investment for a family which may force them to purchase a machine of lower quality that in the end makes the total cost¹⁰ higher.

2.3 Extended Producer Responsibility for servitization

Design of servitization extends from designing the physical product to also include design of the product-service system and even society. Current industrial practices show that organizations could attempt to extend their responsibilities in a number of ways to close the loop, e.g. either by taking back used products from consumers, or by taking financial responsibilities to organize collection, reuse and disposal, or by taking informative measures to improve consumer awareness, etc. (Pal 2016). As previously mentioned, the six mechanisms of extended responsibility through servitization are foundational to this study, and are described below in relation to design issues for servitization. These mechanisms are subject to trade-offs between them and there is no one-size-fits-all solutions to accommodate all needs.

2.3.1 Value-adding services for extending physical responsibility

Value-adding services for extending physical responsibility; Pal (2016) highlights that

⁸ <https://www.rolls-royce.com/media/press-releases-archive/yr-2012/121030-the-hour.aspx>

⁹ <http://www.lighting.philips.com/main/services>

¹⁰ <https://www.bundles.nl/en/>

organisations that exercise complete or partial control of the value-adding service are able to render higher physical responsibility of a product. Such mechanism can enable higher resource efficiency and extended responsibility through services such as repairing and re-designing (Pal 2016). Additionally, reversed logistics is a necessity in product-service systems to manage the first-last mile problem. This is typically associated with public transportation and the inconveniences commuters face when they're going from home to a transit station and then from the station at the other end of the trip to a final destination (Staff 2009), and applies to servitization for used garments too, primarily the transportation of a garment from the location of a customer to the location of the service. Pal (2016) also highlights the necessity of design and textile material competencies required for managing a system for servitization of used garments as well as the associated IT-infrastructure that are needed to locate garments, service stations or other to motivate users.

2.3.2 Complete product leverage for extending physical responsibility

The current structures for use and reuse of fashion items are normally associated with complex ownership structures. Pal (2016) indicates that systems where one actor has complete leverage over the fashion item is more convenient for the involved parties. For the purpose of investigating clothing rental, the mechanism could be applied in clothing rental for expanding the business model to new markets, where instead of ownership, physical responsibility is transferred to a customer (e.g. subscription) or a partner (e.g. collaborative partnership for short-term rental).

2.3.3 Collaborative partnership for extending financial responsibility

Pal (2016) highlights the importance of building collaborative B2B-partnerships within the product-service system. The network is an important area for companies in the system who cannot perform all the value adding activities individually (Pal 2016). Collaboration with third parties can help implement PSS models faster and more flexibly (Ellen MacArthur Foundation 2017), while competences that are lacked in-house can be shared between the partners (Pal 2016), for example for delivery and expanding the concept with partners such as 3rd party logistics and other retailers. This does not contradict the convenience of complete product leverage but a trade-off between them has to be made (Pal 2016).

2.3.4 Information transparency for extending informative responsibility

Efficient information sharing among various stakeholders and network partners is crucial for reducing information asymmetry and is essential for exercising information responsibility in used-clothing product-service systems. Companies engaged with such transparent communication by, either sharing production and company affairs publicly or through constant exchange of information with the business partners managed to execute high level of information responsibility by disclosing their practices and by informing about their undertaken responsibilities (Pal 2016).

2.3.5 Raising awareness for extending informative responsibility

Sustainability-related events and workshops, like swapping and redesign workshops, illustrates how a company can make an effort to inform users and consumers about the benefits brought by various aspects related to product-service systems and circular economy and thereby stimulate and support a shift towards sustainable consumption practices (Pal 2016).

2.3.6 Platform-enabled networking for extending informative responsibility

Digital platforms serve as a tool to organize coordinated tasks and network the partners and users, and generate seamless multi-sided service experience. This results in services providing enabling platforms for customers, describing new type of stakeholder relationships and/or partnership. Such forums resemble “experience-centric networks” of user communities essential for value co-creation to ensure higher information coordination to extend responsibility (Pal 2016).

2.4 Societal, environmental and economic benefits

Society

The results of the “International Fashion Consumption Survey” by Greenpeace showed that one third of their combined European and Asian survey sample admitted to feeling empty, not belonging, bored or lost when not shopping for new purchases as much as up to two hours daily. This makes it even clearer that consumers are no longer shopping because of a true need for new garments, but rather because they are longing for excitement, satisfaction and confidence in front of others as part of personal fulfilment. The concept of emotional design by Chapman (2014) describes an approach to designing products with an end goal to create a deeper and more sustainable bond between people and their possessions. The benefits of servitization is similar to emotional design in terms of creating a bond that alleviates the need to continue to consume new garments, thus reducing the environmental impact that ultimately affects the society in a negative way.

Environment

One of the many interesting aspects of servitization, according to Tukker and Tischner (2006), is that it serves as a way to improve resource efficiency leading to a reduced adverse environmental effect for society. This, as previous research points out, makes it a feasible solution for the highly resource inefficient and environmentally stressing global textile-fashion industry (Pal 2016). Servitization in the form of incremental design could eventually lead to design for circularity, where the end stage for the product is already considered as well as acted on in the design phase. This would enable the users to reinvent their garments instead of discarding them, and thus facilitating the servitization even more.

Industry

Servitization hold the capability to generate a new revenue stream and a competitive advantage. Also, an alternative business model concept employing a form of servitization where used garments are redesigned or upgraded aims to reduce the dependency on natural resources as well as at the same time strive for improved product longevity (Pal 2016). This fact gives servitization in this project great potential to accentuate sustainability by, according to Tukker and Tischner (2006), extending the value of tangible products through intangible services. Rental business models, as alternatives to more traditional sales models allow customers to access garments for one-time occasions and short-term needs without increasing demand for new clothing (Ellen MacArthur Foundation 2017). On the other hand, as highlighted by the foundation, businesses benefit from creating new streams of profit while building long-term relationships with their customers.

3. Methods

The cases presented in the report have similar aims, as both address problems, which are inherited flaws of the apparel and textile industry, by developing novel concepts for circular

business models. As action research is a collaborative approach involving all those who are stakeholders taking systematic action to investigate and resolve issues with solutions appropriate for specific local situations (Bryman 2012; Stringer 2007), it was found to be appropriate for investigating and evaluating Houdini's Rental business model, followed by developing potential solutions for updating and expanding the concept.

Relevant to the method is sampling of participants who as key stakeholders are 'affected by or have an effect on the problem or issue of interest' (Stringer 2007). Thus, key stakeholders in the study were identified as: (1) Houdini's Head of Design & Product being responsible for the concept; (2) Houdini's and Copperhill Mountain Lodge's managers being responsible for implementing the concept in their locations and are familiar with what are the needs of the area and their customers; (3) Houdini's customers and/or people interested in the brand being a source of relevant information regarding their needs and how they perceive the concept. Besides identifying the stakeholders, key concepts related to the sharing and product-service systems were identified and reviewed. With circular and sharing economy, and product-service systems as a basis, five core elements relevant for renting garments to support sustainable consumption were identified, guiding the development of the interview guide with Houdini's store managers and the workshop structure with the customers. For the Monki Re:love case, action research was found to be appropriate for the overall purpose of developing and testing a novel business model concept where servitization is used to add value to already existing products. As the goal of action research is to understand and develop processes in joint learning within the context studied, the study contributes to the practical concerns of an organisation, while also contributing to the development of science (Gummesson 2000, Näslund 2002). Furthermore, action research suits the field of sustainability in textile value chains well, while it has been emphasised by Winter (1989) that good action research includes studying objects from several directions since some problems require a multitude of research methods to find a solution. Thus, both cases are studied through an action research approach, complemented by factorial experiments, observations, interviews and surveys in order to examine the economic implications and feasibility of such business models focusing on servitization.

3.1 Data collection and analysis

Case I

Primary data for Case I was derived from key stakeholders in the form of informal meetings and semi-structured interviews. Semi-structured interviews were utilized, as they allow for a variation of the sequence of the questions, and for the researcher to ask additional questions if found relevant (Bryman 2012). The interviews were held in February and March in 2018, and lasted approximately 0.5-1.5 hours. Additionally, a workshop was held at the Houdini store in Gothenburg with customers and those interested in the brand and the Rental concept, in order to understand the customer perspective and preferences for renting garments.

The interview guide directed at store managers was structured according to the five core elements identified to be relevant to renting garments: Time, Location, Cost, Booking and Delivery, and Value adding. Additionally, the guide focused on the store, its customers and the perspective of each of the managers respectively. During the interviews, comprehensive notes were taken regarding the answers, and if necessary, further questions were asked besides those in the interview guide. After each interview, the notes were better organized and divided into the core elements to facilitate the analysis of the data. Furthermore, if additional questions were raised, the managers were contacted by email.

Supplementary quantitative data was gathered from Houdini regarding the statistics of renting garments in their stores from May 2015 to March 2018. The quantitative data was available for the five stores in Sweden. The goal of analysing the quantitative data was to support the qualitative findings from the interviews that would guide the development of suggestions for an updated Rental concept, along with possibilities for expanding the concept. Furthermore, the quantitative data was utilised for projecting an economic feasibility of the suggestions for different scenarios.

Case II

Data for Case II was gathered during 2018 in several stages. The first testing of the printer was initiated in February 2018 with 90 factorial experiments plus several pre-testing pilot runs were carried out at the Re:textile laboratory to evaluate the feasibility of the in-store PSS design from a service provider perspective. The purpose of these experiments was to gain a better understanding of the performance of the Brother GTX4 printer, regarding print quality as well as gather data of the standard execution time and print cost incurred during the mass customisation process as part of the PSS.

The data documenting the times of each of the eight steps taken, as well as the overall time of each experiment, were uploaded into the Python software to analyse the quantitative numbers regarding their means, standard deviations, minimum, and maximum. Additionally, matplotlib, a 2D plotting library, was used to generate boxplots based on the collected data including all calculations for the median (the 50th percentile), the 25th percentile as well as the 75th percentile and the inter-quartile range. All relevant consumption values of the inks, pre-treatment and maintenance fluids used during the experiment were documented, with the cost of each individual price calculated per ml for a total cost per print.

Within the Fashion Days at the Textile Centre in May and June 2018, 40 test subjects were invited to test the developed PSS through an escapist customer experience based on the four realms of experience (Gilmore and Pine 1997). The test subjects were directly involved at the design level by choosing a design through a product configurator, as well as the production level through observation and assistance in the production process. After the customisation process, the test subjects were asked to fill in a questionnaire with closed-end questions to understand their experience and satisfaction of the PSS, its configurator and the embedded co-creation process.

The questionnaire was categorised into six variables: (1) demographics, (2) fashion interest; (3) satisfaction with the experience; (4) satisfaction with the product choice (incl. willingness to pay); (5) design for circularity; (6) PSS as brand strengthening. One of the researchers took on the role of a non-participant observer, which is described as a data collection method used during which a researcher enters a social system to passively observe activities, events, behaviour, and interactions from a distance without actively taking part in the social setting (Williams 2008). The test subjects were introduced to the non-participant observer before the customisation process to avoid ethical issues. Notes taken during the observation serve as a way of cross-checking and complementing the findings of the questionnaire through triangulation.

The research conducted for the Monki case resulted in an in-store event called Re:love where customers could customise their own or new garments. The events were held in Gothenburg and Stockholm over the course of four days in September 2018. A prototype configu-

rator on two iPad's were available to the customers where they could visualise and choose artwork stickers to be printed. The customers were asked to answer a short customer survey in return for the free printing event.

4. Case I – Houdini Rental

4.1 Case description

The first case aims to examine the rental business model of Houdini Sportswear (hereafter "Houdini"), a Swedish outdoor clothing brand established in 1993 offering a wide variety of garments from underwear to outerwear. The company aims to re-connect people with nature, by implementing versatility, timelessness and durability as a part of their design philosophy, aiming to move away from a linear economy towards a sustainable circular business model. This includes business model innovations such as introducing concepts for Rental, Repair and ReUse (Houdini Second Hand) and Recycle in order to slow down the resource loops, and focusing on offering services rather than products. In order to further innovate the Rental business model, the concept that is currently offered in their six stores Sweden and Norway has been addressed, along with the Copperhill Mountain Lodge hotel in Åre.

Currently, Houdini offers renting of shell layers and mid layers in their six stores: Gothenburg, Oslo, Stockholm, Täby Centrum, Barkarby Outlet and Åre. Besides the brand's own stores, renting shell layers has been offered at Copperhill Mountain Lodge (from here "Copperhill" and included in the term 'store') since 2017. The current Rental business model is presented on Figure 3 with the service offered internally in Houdini's own stores and externally through Copperhill. While all the stores are focused on similar goals, implementing the Rental concept in each can depend on the location and capacity of the store, together with which types of customers are the main target group. Thus, each of the store managers, along with a manager from Copperhill, were interviewed in order to understand how they have implemented the Rental concept and to understand the managers' experiences and suggestions for improvement.

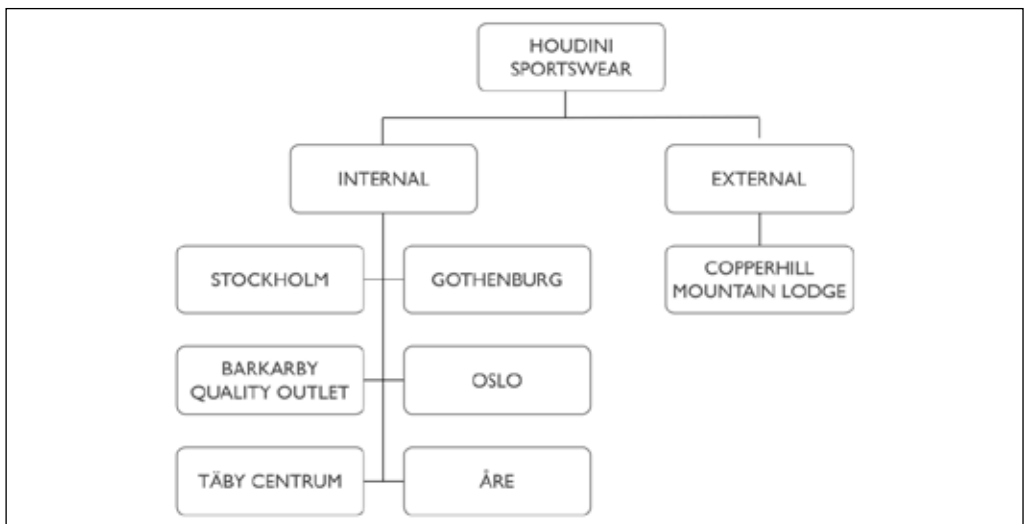


Figure 3. Houdini's current rental business model.

4.2 Garment rental as a service – core elements

Store focus and location

As previously described, there are 5 stores located in Sweden, one in Norway and an external collaboration also in Sweden. This is also related to the focus of the store, as for example the outlet at Barkarby sells collections from previous seasons, and thus presenting the rental styles could be confusing to the customers. According to the managers, the concept currently is simple for the customer, and offering it in-store helps to enable a better and more experience, while also having the potential to change their mind-set positively in terms of sustainable consumption. Furthermore, by implementing the concept Houdini Hangouts, the brand hosts events with customers to bring them closer to nature by organising activities where they can try out Houdini's garments.

Most customers rent for the first time or annually for their winter vacation, and thus need to rent the whole set of a jacket and pants. Their reasons for renting are shorter business trips, winter vacations where they only use such garments, families having forgotten to bring their garments, or first time users trying new outdoor sports, or experienced people interested in the brand or its new styles. Most customers return for the quality of the service and the products, and the sustainability of the service. Thus, they are mostly positively minded towards the concept, and prefer renting to buying due to the higher price of the shell layers. On the other hand, the customers in Norway and Copperhill are described to be interested in sustainability and the concept, but as they can afford to buy, they value the convenience over the price. Furthermore, as renting garments is a newer concept in the Norwegian market, it may be difficult to get the message of sustainable consumption across to the consumers, as clothing is more of a personal product, than compared to cars for example.

While all stores offer the Candid style shell layer for a jacket and pants, they currently aim to also make the Power Houdi, which is a mid-layer, available for customers that are interested. If not available in the rental collection, the requested garments are taken from the main collection, if possible, to meet the customer demand better. Some stores also offer only AW (autumn/winter) styles, due to their location or low interest from the customers for the SS (spring/summer) styles. Furthermore, customers can be meticulous about the colour of the garment they wish to rent, but as the styles for rental are also produced in new colours for testing purposes, they guarantee the correct size to the customers, but not always the colour. Furthermore, it was described to be difficult to offer a good range of sizes in the end of the season, as the garments from the rental collections are also sold to customers on request.

Time

All stores and the hotel offer the same time periods for renting the shell and mid layers, including pick-up and return on the previous and next day respectively. The periods are from Friday to Monday, Wednesday to Monday, and one week. Thus, the periods are 2 days, 4 days and 7 days respectively. Depending on the capacity, some stores can be flexible with enabling different combinations if requested by customers. For example, Barkarby and Åre stores can be flexible with offering even 1-day rentals, while the Gothenburg manager stated that customers have been interested but none have requested it so far. On the other hand, the store in Stockholm would enable it, but sees it difficult, as the garments are currently washed

by an external service provider. Furthermore, the manager in Oslo sees this option as not possible, due to the long lead times required for washing the garments, which would mean that the customer would have to pay a higher price for a 1-day rental to break even, which is also emphasised by the manager at Stockholm.

The most common time periods for renting the garments differs by store, and all three offered periods were pointed out to be most popular by different store managers. As presented in Figure 4, the most popular period is one week, followed by the weekend, with both periods connected to renting out a set, which is more popular than renting out one piece. This correlates with the description from few of the stores, where most customers are first-time renters and need to rent both the jacket and pants.

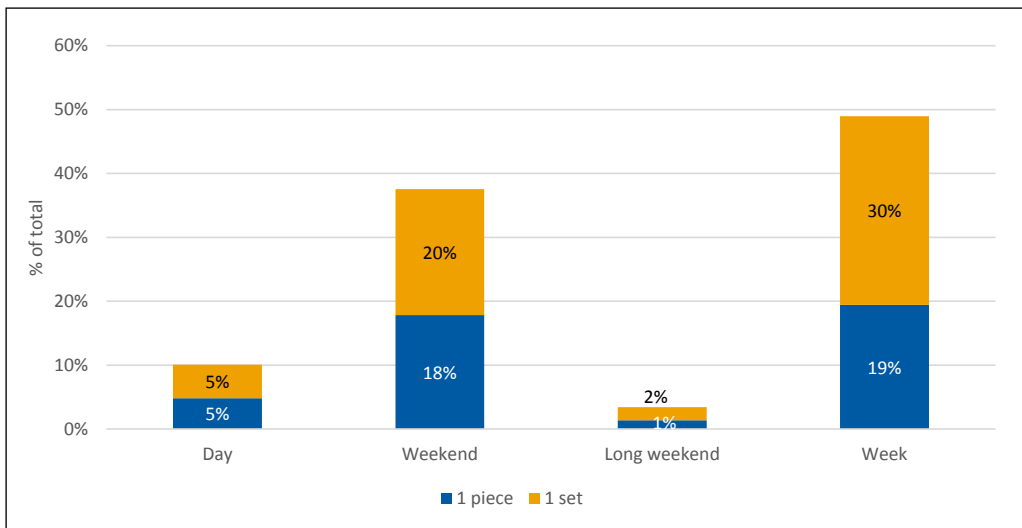


Figure 4. The percentage of rents for each period offer.

Periodically, the AW season is more popular due to people needing to rent shell layers, which are more expensive and less used as they are aimed for use for winter sports, while SS season is less popular. Throughout the three years, AW seasons have been 9.75 times more popular than the SS seasons, with a total of 90,7% of the rents taking place during the AW seasons, and 9,3% rents during the SS seasons. Due to renting the AW shell layers being more popular, the stores in Åre, Oslo and Barkarby, together with the Copperhill Mountain Lodge don't offer the Rental concept during the spring and summer seasons.

Cost

The prices for renting Houdini's clothing are based on the same price list in all the stores and the hotel. During the AW season, when the interviews were conducted, the prices were presented for shell and mid layers for adults, and shell layers for junior sizes from the AW collection. The time periods are defined through weekdays: Friday-Monday, Wednesday-Monday, and a one-week period, with prices ranging from 300-900 kr/offer for junior sizes, to 400-2400 kr/offer for adult sizes. In general, there has not been negative feedback regarding the cost of renting Houdini's garments as the brand's products are offered at a higher price range. Furthermore, due to higher cost of purchasing the garments, renting them has received positive feedback as it enables a wider range of customers to access the brand's

products regardless of their financial capabilities. The cost of renting a garment for Houdini depends on landed price (when it reaches Houdini's warehouse), the cost of handling the garment, including washing, and how many times the garment is rented to reach break-even. The cost of washing is roughly 20 SEK/piece¹¹ at the stores using their own washing machines, while during the interview periods the Stockholm store had been using a 3rd party service for cleaning the Rental collection garments at the price of 175 SEK/piece.

Booking and delivery

The booking routine is general for all stores although adjustments are made by each store depending on their experience with the routine, and the capacity for storing and cleaning the garments. Overall, the booking routine first includes explaining the concept to the customer, and checking the availability before booking, which can be done up to 3 weeks in advance. Besides that, when picking up the garment(s), customer information is requested from the customer, who is also asked to sign the contract along with the terms and conditions and to pay for the service. While returning the garment(s), the staff is required to look for any signs of damage followed by cleaning, or booking the cleaning, and preparing the garment(s) to be ready for the next customer. Following the routine has been described as difficult by some managers in the stores that do not have much experience with renting overall, besides it being complicated for the staff who are working in the store part time and rarely.

Delivery of rented garments is currently not offered and according to all store managers, there has not been interest by the customers due to the concept of renting clothing being relatively new, which means that the customers have never done this before and thus they have low expectations for the degree of the service. As stated by a few managers, delivery to different locations can complicate keeping track of the stock, similar to pick-up and return to different locations as described below. Furthermore, home delivery before a vacation would create more concerns if the package would arrive on time or not, along with delivery back to the store with enough time to clean the garment(s) before the next customer.

Value adding

Different value adding aspects were discussed with the managers, both what is currently offered and what could be of interest for both the brand and the customers. First, washing of the rented garments is included in the price, and organized and carried out by all the stores. Most stores already have a washing machine in-store, and the rest are planned to have one in the near future. Second, pick-up and return to different location was discussed. As with delivery, all store managers have stated that there has not been interest by customers or very little interest without the actual need to pick-up and return the garments from and to different locations. While both would be value-adding services for the customers, it would make it complicated for the stores to keep track of their stock along with economic and environmental concerns related to increased transportation. Nevertheless, if requested by the customer, the store can be accommodating to the customer's needs.

Third, the managers were asked about the potential of offering insurance for the garments. As explained by a couple of managers, some customers have been interested in buying insurance as they are concerned about their responsibility in terms of how much wear and tear a garment is allowed to have, as this is something difficult to define. All agreed that

¹¹ Calculated by Houdini Sportswear

offering insurance would be a good idea, which would offer contentment to customers enabling them to enjoy the garments without worrying about creating any damages. One of the managers stated that the insurance should be inexpensive so it would not feel like too much for the customer. Additionally, it should be clearly tied to the terms and conditions making it clear for the customer what their options and responsibilities are. Furthermore, the managers were asked to describe previous issues with damaged garments being returned by customers. Only three stores out of the six have had problems with damaged garments on a few occasions. In Gothenburg, the damage was repairable and thus the garment was sent to the central repair service in Stockholm. In both Gothenburg and Åre the customers have not been charged for the damage, though in Stockholm it was highlighted that the customer should pay for the garment, possibly at a discounted price.

Fourth, enabling customers to buy the styles after renting them is offered in all stores besides the hotel. The stores in Oslo, Täby and Barkarby have had no experience with selling rented garments but would sell a new garment with a discount of the rental price, as they are interested in keeping the Rental garments until the end of the season. The same is emphasized by the manager in Stockholm. In Åre and Gothenburg the managers sell either the used Rental garment with a higher discount or a new garment depending on the style, colour and sizes that are in stock.

Success factors and challenges

According to all six managers of the stores, the greatest success factor is Houdini being unique and in the forefront in the market of renting (outdoor) garments, which sends a good message about the brand along with its sustainable business model and goals. Emphasizing that the customer does not need to buy the product to be able to use it, initiates a conversation over sustainability, which is perceived by customers positively and additionally facilitates introducing the ReUse concept. Furthermore, the Rental concept enables all customers to afford and access the brand's high-quality garments regardless of their financial capabilities or how often they actually need the garment. This relates to Houdini's overall goal of 'being driven by the nature and the experiences it gives us'¹², by allowing more people to access nature and re-connect with it. Another success factor emphasized by all is the simplicity of the concept, as the service is made as easy and clean for the customer as possible.

Challenges mostly differed based on the store/hotel, although one difficulty was common for most stores. According to a couple of the managers, following the booking routine and time periods and price lists are difficult to understand and follow, especially for staff not working very often. Furthermore, as the schedule and contracts are kept track of separately, it creates further difficulties. Related to booking, it has been explained to be complicated to follow the periods as they are tied to specific weekdays, and not as full days; especially as it is not specified from which time it counts as a whole day. Emphasized by the manager in Gothenburg, are the articles used in Houdini's system, which are tied to the lengths of the period of renting and whether one or two pieces are rented, which complicates combining a different period requested by the customer.

Furthermore, raising awareness of the concept and its benefits to customers has been difficult, as it requires changing the customer's mind-set and their view on their consumption

¹² <https://www.houdinisportswear.com/us/about/the-houdini-manifesto>

habits. The manager in Oslo emphasised the fact that renting garments is quite new and special in Norway, thus making it even more complicated to spread the benefits of renting, as the prices of the garments for sale is not an issue for the customers. Additional challenges in general were related to offering selected styles for rent, while the customer may be interested in another model or new style.

4.3 Technological considerations

When it comes to technology considerations, implementing novel logistics solutions should be considered, as reverse logistics are a critical stage in a new textiles economy as products are moved between the stakeholders repeatedly (Ellen MacArthur Foundation 2017). In order to maximise margins and customise experience, customer segmentation, scale and last-mile choices are relevant to take into account. Furthermore, businesses should invest in technology to track their products and materials along with implementing customer drop-off and pick-up models facilitating the reduction of logistics costs and challenging the last mile problem (Ellen MacArthur Foundation 2017). In terms of marketing, although businesses implementing new rental business models are in a good position due to their experience with marketing, the success of those business models depends on how customers accept those novel models (Ellen MacArthur Foundation 2017).

4.4 Results

The following sections entail the results of a workshop carried out with Houdini's customers, along with suggestions for updating and expanding the rental concept to further emphasize and extend their garments' useful lifetime.

4.4.1 Consumer engagement

A workshop was carried out on the 8th of March 2018 from 18.00 to 20.00 in the Houdini store in Gothenburg. The workshop was organized by Houdini Sportswear, Protect Our Winters (POW) and Re:textile (University of Borås) in order to understand the consumer perspective of Houdini's Rental concept and how it should be innovated for improvements and expansion. The participants were divided into groups, with three groups with five participants and one group with four participants. A total of nineteen participants took part of the workshop, including two Houdini employees and a project leader from the Re:textile project.

The workshop was structured into the same five core elements used for the interviews - Time, Location, Cost, Booking and Delivery, and Value adding - with explanations provided for each of the elements. The first, 'Time' included aspects such as rental period and its flexibility, while the 'Location' entailed aspects regarding location and potential partners offering garment rental. The third - 'Cost' - included aspects such as cost of the rental, insurance, offers for different target groups etc. 'Booking and Delivery' entailed aspects related to the booking routine and which delivery options should be offered, while the last element 'Value adding' was defined regarding which value adding aspects and/or activities are relevant for the customer. The participants were asked to spend 10 minutes brainstorming each element and write down their ideas, while during the last part of the workshop they were asked to define a final concept for Houdini's Rental concept based on their ideas.

Regarding 'Time', flexibility and possibility for combining different periods was emphasised by all four groups. The time periods should be highly adaptable to the customers' needs, as based on the customer, the company should be able to please/fill the needs of every custo-

mer group. Regarding the periods, everything from one hour to one season was suggested to be of interest for the customer. 'Location' helped identify a few different aspects that the participants found to be relevant. Common in all four groups was the idea of Houdini "owning" the concept and being the main service provider for Rental, while collaboration with chosen hotel chains and multi-brand retailers was additionally suggested. Those collaborations entailed focusing on organizations with similar prestige and ethical values to those of Houdini Sportswear, aiming to reach the same target groups. While offering the concept in Houdini's own stores was certain to remain relevant, an additional suggestion was related to offering peer-to-peer rental facilitated by the brand's stores. Furthermore, offering garments for rent online was suggested by all groups, emphasising the option of choosing a garment online while picking it up in the store. Regarding offering rental of garments in ski resorts, there were different opinions between the groups. As a possible challenge with offering Rental online, the issue with choosing the correct size was identified.

'Cost' identified ideas such as offering different price models/packages for different target groups, along with determining prices based on which collection and/or year the garment requested for rent is from. This would base the price on how used and stylish the garments are, along with offering discounts for families and students. Furthermore, the packages available should include basic, medium and premium offers to meet every consumer's need. Additionally, insurance was of interest and it was offered to be based either on the garment's retail price or on the rental period, for example 50, 100 or 200 SEK for 1 day, 1 weekend or 1 week respectively. For 'Booking and Delivery', booking in Houdini's own stores, online and chosen multi-brand retailers was again suggested. Delivery to home, hotel and postal office was of interest, although sustainability affected by transportation impact was concerning. It was highlighted that the customer should walk or take public transport to the store; furthermore, it was suggested that the customers who do so could receive discounts on their purchase or rentals. Not using packaging was identified as a unique selling point (USP).

Lastly, 'Value adding' brought out very different ideas from all the groups. First, the concept of Houdini Story was defined, where value is added by customers sharing locations and pictures of where they used their rented Houdini garment through an app. Furthermore, the garments environmental footprint was suggested to be visible in the app, along with being able to compare it to a purchased garment's footprint. Another idea related to an app was to allow customers to collect points based on how many days they have rented garments from Houdini, resulting in collecting points within a loyalty programme. Additional value adding offerings were premium collections as exclusive rentals, and collaborating with ski resorts or travel agencies, where the customer could book the vacation and necessary garments together, while also receiving tips about the garments and destination.

4.4.2 Suggestions for updating and expanding the Rental business model

The following chapter presents suggestions for improvements and expansion of the Houdini Rental business model in terms of the five core elements while taking into account the design principles, technology considerations, marketing strategies and logistics solutions. The suggestions aim for an improved experience for the customers, more efficient system for the staff, and mainly for scaling up of the business model nationally.

4.4.2.1 Updating the business model and its feasibility

Store focus and location

In relation to the store focus, the main suggestion is offer more styles for rent in order to increase the selection for the customer with products suitable for a variety of customers based on their characteristics. At the same time, the rental collection should consist of basic colours, such as black, along with additional seasonal colour(s) in smaller quantities as alternatives. This would facilitate extending the products' lifetime by renting them for several seasons, while also meeting customers' expectations by offering several styles and colours, beyond the currently offered core products.

Secondly, due to proven interest from customers regarding selling their used garments at Houdini stores, it could be of interest to offer a similar peer-to-peer service through the Rental concept. This would enable Houdini to earn additional revenue through the customers' garments without any costs besides the relatively low handling and washing costs per piece. Furthermore, the brand would be able to prolong and strengthen the relationship with their customers, while renting used garments would even further demonstrate the quality and thus sustainability of Houdini's garments. Furthermore, in order to protect the owners of the garments, it might be beneficial to implement mandatory insurance fee for the customers renting those garments.

In terms of marketing strategies, it is recommended to implement solutions in-store that would facilitate catching the customer's attention and interesting them in the concept. Furthermore, as the space is limited in terms of displaying the Rental collection garments in-store, signs such as "You can also rent this jacket" or "Instead of buying, rent this jacket" would better communicate the concept, while also making it clear for the customer which styles are available for rent.

Lastly, as the stores in Barkarby and Täby have a specific focus, with outlet and ReUse sales respectively, it is recommended discontinue offering the concept in those locations to enable the stores to better concentrate on their store focus and target groups. At the same time, both of these stores are still able to introduce the customers to the brand and the Rental concept, and direct them to the right locations in case of interest, while increasing customer service for the other concepts. Furthermore, costs are being lowered, as there is no need to invest in new pieces in those stores, as almost no revenue is earned through Rental, while the staff in those stores is not required to be trained for the concept.

Time

Regarding time, the main suggestion is to base the rental periods on 24 hours instead of connecting the periods to specific weekdays. As presented in Table 1 in the next section, the time periods should range from, and be presented to customers as, 1 day (24 hours), to 3 days (72 hours), 5 days (120 hours) and 1 week (168 hours). The goal is to facilitate the service for the staff, mainly for being able to combine different periods based on the customers' needs. Furthermore, this will help in defining the specific return time after the customer has picked up the garment(s), which in turn will simplify scheduling the garments for renting and washing.

On the other hand, while offering garments for rent for 24 hours or less might be appealing for the customers, the downside is the need for more washing, which together with the impact of potentially added transportation cost and impact might not be optimal for the brand economically and environmentally. As highlighted by Muthu (2015), the consumer phase, in Houdini's case the handling and washing phase, is the major hotspot for normal wear and use, while being highly dependent on the methods of washing and drying. Thus, it is recommended to assess the necessity and environmental and economic impact of washing the rented garments after short-term use.

Cost

As described in the previous section, it is recommended to base the periods along with the prices on a 24-hour period (see Table 1), with decreases in the price for the customer for a longer time period.

Time period				
Days	1 day	3 days	5 days	1 week
Hours	24	72	120	168
Men/Women				
1 piece	300 kr	400 kr	600 kr	800 kr
2 pieces	525 kr	700 kr	1 100 kr	1 400 kr
3 pieces	750 kr	1 000 kr	1 600 kr	2 000 kr
3 pieces + Power Houdi	900 kr	1 200 kr	1 800 kr	2 400 kr
Power Houdi	225 kr	300 kr	400 kr	500 kr
Junior				
1 piece	225 kr	300 kr	400 kr	500 kr
2 pieces	375 kr	500 kr	700 kr	900 kr

Table 1. Proposed price list.

Further suggestions concerning costs relate to checking the condition of the rental collection after the end of each season, in order to evaluate their condition informing whether the garment(s) can be rented during the next season(s). As described above, renting garments with a classic design and in basic colours, such as black and dark blue, enables the brand to invest less to produce new garments, while decreasing the environmental impact and proving the high quality of Houdini's garments to the customers. Additionally, in order to facilitate decision-making in terms of which sizes and potentially colours to purchase for the season's collection, the rents should be entered into the system in a uniform way in order to facilitate the analysis of the data from each season respectively.

Booking and delivery

Within booking and delivery, suggestions relate to the 'design' of the routine and stock keeping, while aspects related to delivery could be facilitated by technology. Firstly, in order to facilitate the booking routine for the staff, it is recommended to better separate the

'booked' and 'not booked' garments similarly to the system used in the Gothenburg store, while being appropriate to the capacity of each of the stores. For example, depending on the space available, the Rental collection should be sorted on rail(s), on shelves or in boxes. Furthermore, a piece-specific label should always be attached to each garment when in-store, which will facilitate finding and keeping track of the garments. The labels should state the style, gender, colour and size of the garment, and could be for example attached to the sleeve with a clip.

Another option could be to attach a booking sheet per shelf or box (or use Excel) stating each garment stored in that spot (style, colour and size), along with the period(s) when they are booked and washed. This would further facilitate the organisation and booking of the garments for the staff. Furthermore, by utilising technology advancements, RFID tags could be of interest in order to be able to facilitate tracking the garments, how many times they have been washed, etc. while on the other hand leading to higher investments. Regarding the booking system, as described above, booking will be simpler for the staff if the time periods are related to 24-hour basis, based on the number of days instead of them being connected to specific weekdays. Furthermore, this will facilitate collecting statistics if staff will also enter the number of pieces rented, along with the style, colour and size, while the amount can be inserted manually.

In terms of delivery, it can be of interest to the customers as suggested by the workshop results. While offering booking and delivery online might be of interest, it is suggested to carry out a trial of offering delivery in the stores to gain an understanding of customer interest and the feasibility of the service. By understanding the interest from customers to either deliver and/or return from their home or destination location, the service can be later expanded to cover greater areas or the whole country. Furthermore, through an initial trial, the number of SKUs can be kept lower in order to facilitate the trial. Reusable packaging, such as RePack¹³ could be utilised in order to decrease the environmental impact by decreasing waste through utilising a product that can be used up to 20 times. With three adjustable sizes, the packaging should be suitable for all orders and additionally reduce CO2 emissions by up to 80%¹³.

Furthermore, delivery possibilities such as Move by Bike¹⁴ could be further utilised to decrease CO2 emissions in Stockholm and Gothenburg, along with Malmö if the concept will be expanded.

Value adding

In order to add value to the concept, it is recommended to offer optional insurance when renting garments. As an additional value adding option, insurance is suitable for clients who are hesitant about their rights and responsibility when it comes to damage(s) to the rented garment(s). At a low cost, it would be a valuable option for the customer and encourage them use their rented garments more freely. Furthermore, as there have not been many issues with returned garments being damaged, with an estimation of less than 1,4% of the garments being damaged beyond, offering insurance would create additional revenue that would cover the costs of repairing or replacing those garments that are damaged by customers.

¹³ <https://www.originalrepack.com/>

¹⁴ <http://www.movebybike.se/sv/Boka>

While the goal is to offer core products in basic and seasonal colours within each collection, it could be of interest to connect the products with levels, such as Basic, Medium and Premium, based on how many pieces are rented and what type of insurance is included in the price. For example, the Basic offer would not include insurance, meaning that the customer is responsible for 100% of the cost of the garment or its repair. Furthermore, Medium offer would include insurance for 50 SEK/piece, where the customer's self-risk is 50% of the garment cost, while the Premium offer would include insurance for 100 SEK/piece with a self-risk of 0% of the garment cost.

Lastly, in order to emphasise the advantages of the service to the customer, an increase in advertising the concept is necessary to further promote the brand's work leading to decreased consumption and increased product utilisation, which will also introduce the concept to more potential customers. While also being beneficial for the brand, the customers will benefit from gaining access to high quality products at a lower price, avoid having to buy, wash and store garments that are not used often, along with decreasing their consumption.

4.4.2.2 Expanding the business model

The following section presents and describes possibilities for expanding the Rental concept by collaborating with other retailers or organizations, focusing on Sweden, followed by presenting feasibility scenarios for some of the described expansion possibilities.

Hotels

With an already existing collaboration between Houdini and the previously described Copperhill hotel in Åre, it is recommended to continue expanding through hotels, while further analysis of the current collaboration is required based on quantitative data that was not available for this study. Collaborating with hotels is suggested both based on an already existing partnership between Houdini and Copperhill, along with results from the workshop with people interested in Houdini's brand and services. Furthermore, for expanding the concept, collaboration with hotel chains is suggested for reaching more customers enabled by already existing systems catering to traveling customers and their needs for a laundry service, which is attached to the hotel's own system for washing textiles used in the hotel.

Two hotel chains in Sweden are brought as an example, as they are present in several of locations over the country, in both larger and smaller cities, and have similar values to Houdini's, in terms of innovation, transparency, and sustainability. The Scandic Hotels Group's hotels are located for example in Stockholm, Gothenburg and Malmö (three biggest cities in Sweden), while also present in Northern Sweden in Östersund and Kiruna, with both being popular winter destinations. The concept Scandic SHOP is present in most of their hotels, where toiletries, snacks, etc. is sold, and as seen on the pictures below (Figure 5), the shop is located right next to the reception, thus is open and staffed 24/7. Utilising the shops could be of interest to present Houdini's core garments, the Candid jacket and pants along with mid layers, to guests traveling to or within Sweden for active outdoor vacations or are unprepared for any unexpected colder weather. Thus, the hotels capacity for presenting and handling the concept could be utilised, while accessories, such as hats and scarves, could be sold alongside the shell layers available for rent.



Figure 5. Scandic SHOP at Scandic Plaza Borås.

The Nordic Choice Hotels are similarly to Scandic Hotels Group located in bigger and smaller cities in Sweden. Recommended locations are Stockholm, Malmö, Gothenburg, Frösön, Luleå and Gällivare, as they are located in larger cities and close to ski resorts and winter vacation destinations. With the Copperhill Mountain Lodge belonging under the chain as an independent hotel, Nordic Choice could be of interest for collaboration due to similar values and an already existing basis for partnership with Copperhill.

Multi-brand retailers

Besides collaboration with hotels, partnerships with multi-brand retailers are of interest similarly due to established locations and customers. Naturkompaniet as such is suggested for collaboration as they have locations in Stockholm, Gothenburg, Malmö, Östersund and Luleå, which similar to the previously described hotel chains would be intended to act as hubs for offering the concepts to larger areas in Sweden. Furthermore, as Houdini's garments are already sold in both Naturkompaniet's stores and its website, a basis for further collaboration through the Rental concept has already been established. The basis relates to an established relationship between the companies, while also meaning that the brand's garments are known to be available at Naturkompaniet by their customers. Based on these aspects, it is advantageous to offer the concept through the retailer for Houdini to reach and introduce the brand and its concepts to a larger audience, while the customers can access Houdini's garments more easily.

In terms of aspects relating to the partnership, similar to potential collaboration with hotels, the ownership of the garments would affect the quality of the service and the scalability. Furthermore, it can be assumed that retailers such as Naturkompaniet do not have established infrastructures for handling and washing garments that would be returned and taken out of the store repeatedly, it is necessary to develop and apply such systems. This would entail initial investments for washing machines and infrastructure necessary for offering the service by either Houdini or the partner.

Other

With Houdini's own central warehouse shipping products to customer purchasing from their web shop, the brand could additionally offer their garments for rent through the same site.

Although offering the concept online has been previously trialled online through an external platform, it is suggested to initiate another pilot test to offer the concept through Houdini's own website in order to better understand how the service should be thus structured and to better understand customer demand. As the previously trialled online platform did not function as expected, utilising Houdini's website should facilitate offering the service with minimal initial investments to modify the system for renting garments. In order to facilitate the service, it is recommended to exclude the Rental collections in the stores in order to reduce the workload of the staff. Furthermore, while the stock from the warehouse can be rented similarly to purchasing them, returned garments can be re-entered to the system by the warehouse staff after every time a garment is returned, inspected and washed.

While online C2C platforms for collaborative partnerships, such as Tradera and Sellpy could be of interest due to their established networks for handling, washing and distribution; offering the concept through Houdini's own website should facilitate customers finding the service and creating a clearer connection between the brand and the concept while further introducing the brand and its sustainability activities to the customers. Furthermore, as garments sold on the previously described websites are mostly used, it would mean presenting used and new garments at a similar price point, which could lead the customers preferring to buy instead of renting as was described at Houdini's outlet store at Barkarby. While keeping a higher inventory in stock to offer a wider selection for the customers would be beneficial, it would also require higher initial investments for producing the garments. Thus, it is recommended to start with a simple selection of one style and colour in order to test the concept and later on increase the number of SKUs.

With the concept offered through their own website, another possible solution besides Houdini's central warehouse and distribution centre in Sweden could be 3rd party logistics service providers. Similarly, the service provider would ship the selected garment(s) to the customer, and with return inspect them and if necessary clean, impregnate, repair, etc. In terms of shipping and returning the garments to the selected warehouse(s), a combination of distribution methods could be used for economic and environmental advantages. For example, if the customer is located in the bigger cities, a combination of trucks and bicycles, such as the Move by Bike service¹⁵, could be utilised. Otherwise, with the customer located in smaller cities or areas, only normal distribution methods are available for use. While it can be assumed that washing facilities are available at the warehouses, initial investments might be required by either Houdini or the partner for installing washing machines and the infrastructure necessary, if already not existing.

Furthermore, service providers, such as Washypop¹⁶ in Stockholm might be of interest if the Houdini stores or potential multi-retailer partners are not capable of handling the cleaning of the rented garments. The concept can be compared to for example Airbnb or Uber where the service is provided by private people that can accept requests for laundry whenever they are available, and is intermediated by the online platform. The price is set by the customer that should reflect how much they (i.e. Houdini) are capable of paying for the service, and is accepted or turned down by the people offering the laundry service.

¹⁵ A bike delivery service offered in cities such as Stockholm, Gothenburg and Malmö (<http://movebybike.se>)

¹⁶ An online laundry service provider in Stockholm (<http://washypop.com/about-us/>)

5. Case II – Monki re:love

5.1 Case description

The first study entails a collaboration with a Swedish fast fashion retailer Monki, which is an independent fashion brand under the H&M group aiming to create on-trend collections for young women at an affordable price point (H&M Group 2018). The aim of the collaboration is to develop a novel in-store concept to extend the life time of garments, while also creating a value-adding experience for the consumers. Small flexible manufacturing equipment, in this case the GTX printer by Brother, was to be integrated in the concept and serve as the base for the surrounding additional digital advancements needed to create a complete experience for the consumer. The goal is to allow the consumer customise their garment(s) in the Monki store using the digital printer for garments. A redefined role for the store assistant emerged as well as the creation of a retail setting concept in order for the consumer to part take in the co-creation through a circular supply of textiles and fashion. A further aim of the project is to extend the understanding of feasibility within such context.

Thus, this study tests direct-to-garment printing as a digital tool for enabling fast in-store mass customisation with the aim of prolonging the garments' lifecycle. Whether the garment is second-hand (i.e. brought in by the consumer themselves), or purchased new at the store, in both instances the life time has the potential to be extended. If the consumer brings in an old garment that they deem needs updating in order for it to still be used, the customised printing could be the facilitator for this type of extension. The underlying reasoning as to why the customisation could serve as a life cycle extension for a new garment is the added attachment that the consumer may feel after participating in the customisation process, potentially leading to the consumer holding on to the garment longer (Chapman 2014).

Exploration and development of trial runs was first carried out to to the described redesigning as PSS in a retail setting by the parameters and specifications needed for the implementation of the value-adding. The research and the trial runs were performed at the Swedish School of Textiles by three students at the two-year Textile Management masters programme in cooperation with Re:textile. The project aimed to create a solution space, create a blueprint for the PSS by using mass-customisation, and to design an in-store customer experience around such customisation process. As the study focuses on servitization, customers were allowed to participate in the design stage while being guided by a designer to create a stronger relationship with their garment for further extending its life time.

The functionality of the printer was tested in a proposed retail setting, along with consumer experience with such PSS in order to evaluate the viability of adapting such services to Monki's business model. Moreover, it was tested whether manipulating specific variables such as the colour of the garment or colour quantity used in each artwork would have an effect on print quality, processing time or print cost and how this differed between used and new garments. While those variables had already been identified as having an effect on time and cost by Brother as stated in their manual, the researchers set out to explore how significant, exactly, the effect would be when customising jean pockets and if this could influence the overall feasibility of the Brother GTX 4 as a mass customisation tool for an in-store PSS.

5.2 Technological considerations

5.2.1 Printer and manufacturing equipment

The chosen manufacturing equipment for this project is the small and flexible Brother GTX-4 digital printer and its support equipment, a projector, the Schulze PRETREATmaker IV and a heat press. A digital inkjet printer was chosen due to its suitability for in-store PSS as it presents speedy production capabilities, flexible automation and its ease to be integrated into the value chain. According to Brother (2018), the printer offers integrated and seamless design options with low maintenance needs.

GTX Graphics Lab software is used to configure and save print files with the prepared designs. The software allows the user to configure the final artwork before creating a printable file such as adding text, altering fonts, colours, size or applying filters etc. (Figure 6). Thus, parameters, such as sizing, placing, colour intensity, whether it prints with a white backing or with a more translucent look can be manipulated through the software. Once the design is satisfactory the program enables the user to create a printable file that can be sent straight to the printer or stored in an AR3/ARX4 file format. The print file data holds information such as exact ink usage for that specific printing scenario which provides the user with options for calculating the costs involved. The printer was additionally equipped with a projector to project the print file onto the pair of jeans before initiating the printing process. With such technological advancements, the placement and size of the print were adjusted if necessary to truly fit the intended print area.

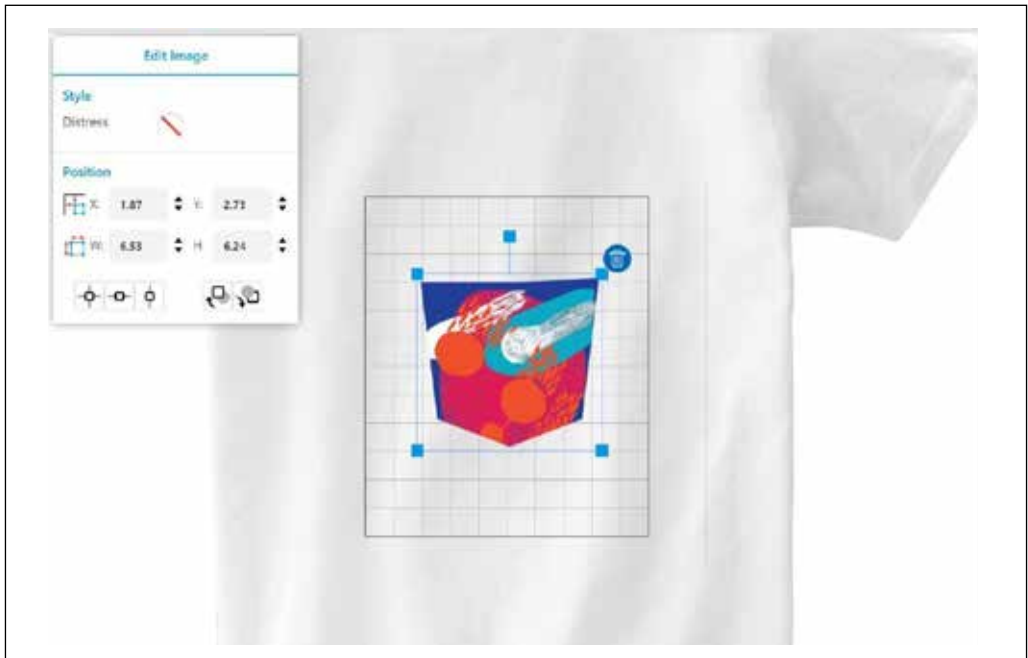


Figure 6. Graphics Lab Artwork Configuration Interface from a prototype print.

Schulze PRETREATmaker IV is an automatic pre-treatment machine to prepare the area for printing (i.e. print light colours on dark fabrics with a sharp quality). The images below (Figure 7) demonstrate pre-testing results to examine the necessary amount of pre-treatment fluid.

15 grams of pre-treatment fluid has been used on the print on the left, and 30 grams of fluid on the print on the right. through visual inspection it was identified that using less pre-treatment fluid resulted in inadequately bright, sharp and correct prints, compared to using the correct amount of pre-treatment fluid



Figure 7. Example of print pilot testing with different amounts of pre-treatment applied to a jeans pocket (Ertelt, Guzun & Scott 2018).

An additional step in the process was to cure the pre-treatment fluid to create a printable surface. This was undertaken by using a heat press to ensure consistent temperature and specific pressure.

5.2.2 Interface-configurator

A product configurator (Figure 8) was developed in the project to mediate the co-design process for redesign as a service, as interaction between the customer and product is an essential element of the service. A framework for developing a product configurator was outlined, based on the project brief as well as an extensive literature review in order to facilitate customer navigation in the customisation process. After establishing the framework, two observations facilitated the guiding of the development and testing of the prototype configurator in a mock-up retail setting with real subjects (i.e. customers). The following image demonstrates the interface of the prototype configurator with its potential artwork and garment colour choices.



Figure 8. Product Configurator layout showing the product, its customisable attributions and the customisation options (Ertelt, Guzun & Scott 2018).

Development and testing of the prototype configurator was conducted in a mock-up retail setting with real customers, as described below. Such prototype testing aids the understanding of what needs to be considered when developing a product configurator for in-store PSS for personalized offerings. The design of the configurator interface also affected the core visual identity of the Monki brand. The configurator was presented to the customers by the Monki store assistant whose role was to act as a co-design facilitator. The customers were given one pair of Monki jeans each with two products attributes: (1) the colour of the garment, and (2) the choice of artwork to be printed on the right-side pocket. There were three garment colours and twenty unique artworks clustered in four categories amounting to a total of 60 product design combinations available to the customer.

5.3 Results

The next sections describe the results from pre-testing the printer with 90 factorial experiments plus several pre-testing pilot runs for testing controlled, dependent and independent variables of the process. Further results are described from a mock-up retail setting with 40 test subjects.

5.3.1 Redesign as a service - process description

The design and construction flowchart encompasses eight steps to transform a pair of jeans into a co-designed and mass-customised pair. The flowchart was developed and tested during a factorial experiment that was devised in the project, where 90 sets of different test cycles were conducted over three days. The main variables chosen during the experiment

were: print speed and total lead time for the customisation process, ink consumption in relation to print types, and colour of the garment colour, as well as whether the garment was new or used. The dark-coloured boxes in the Figure 9 below indicate the processes with fixed process time (i.e. carried out by a machine), while the light-coloured boxes are all manual processes with variation in the lead times.

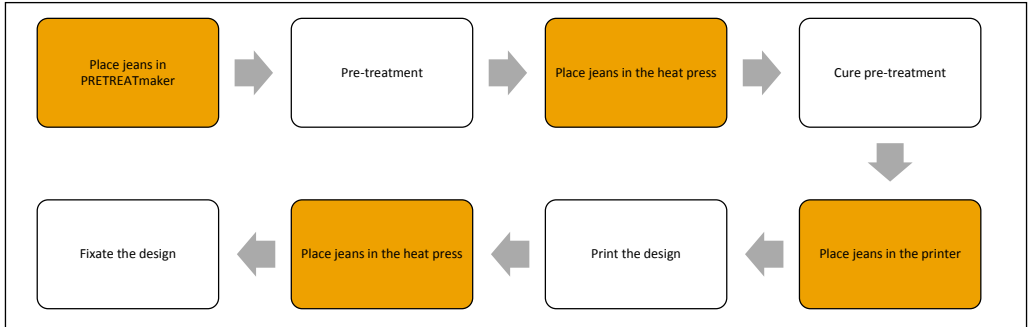


Figure 9. Redesign as a service - process.

Controlled, dependent and independent variables of the process

The variables identified for the digital printing process were those impacting the cost and overall lead time, according to the Brother GTX4 printer manual. The variables are: (1) the garment’s fabric composition determining the amount of pre-treatment fluid required; (2) the garment’s colour (light, medium or dark) as it affects the amount of white ink that is required in the mask layer on which the artwork is printed on; and (3) the variation of the amount of different colours used in the design for the customisation process.

Lead time and process

When measuring the lead times of the different steps of the process, it is necessary to note that three steps of the mass-customisation process performed by mechanical instruments were constant in their lead times, as shown in Figure 10. The “Pre-treatment requires 7 seconds, while “Cure pre-treatment” and “Fixating the design” steps in the heat press require 30 seconds respectively. “Print the design” is the only activity carried out by a mechanical instrument where the time is not a constant thus, where the manipulation of the independent variables presumably will have an effect. The rest of the activities are carried out manually, and those the lead times are not constant.

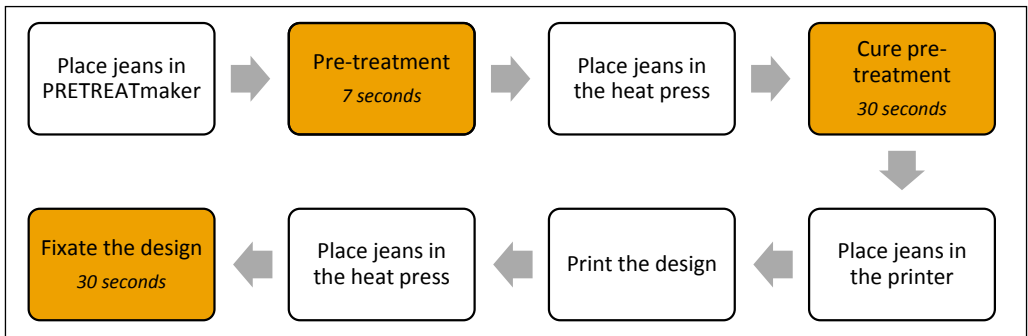


Figure 10. Mass-customisation process with time constants.

Because of the above reasons, when it comes to the time involved in the different mass customisation process activities, the key variable is the lead time for the activity “Printing the artwork”, and its effect of the total lead time for all activities in the mass customization process.

The boxplot in Figure 11 below demonstrates the lead time for the step “Print the design” in the process. To summarize the observations:

- Majority of the boxplots range between 91 and 92 seconds.
- All the test times measured are found within a small time interval of 16 seconds, which could indicate that the speed of the printer is high and the prints fairly small thus the time difference is narrow. Generally, the printing time increases with the increase in CMYK colour volume.
- “Dark Used Jeans HC” shows the longest printing time. The range is between 92 and 94 seconds.
- “Medium Used Jeans LC” holds the least printing time of 79 seconds, ranging maximum up to 81 seconds.

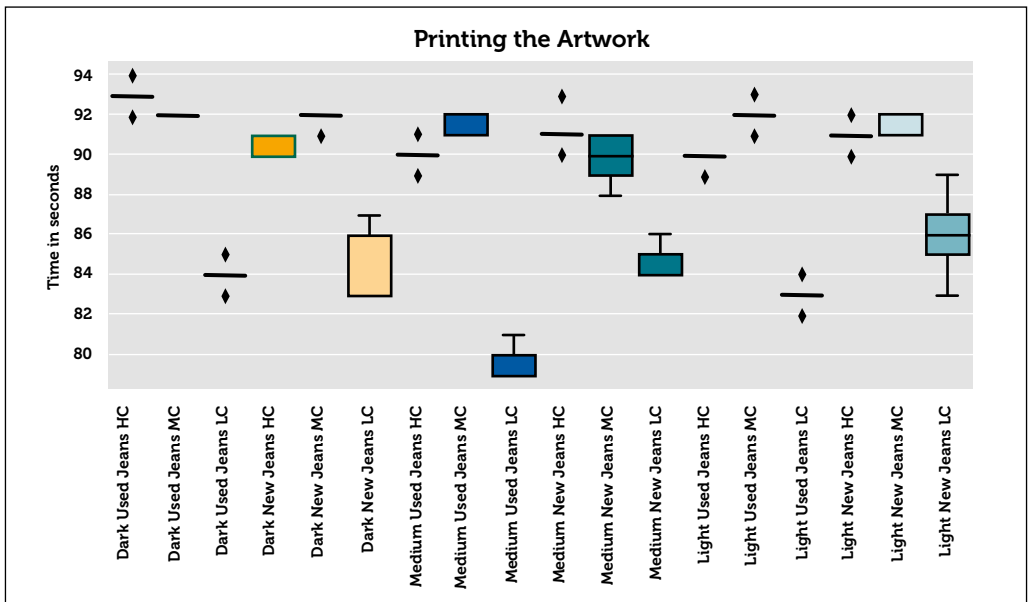


Figure 11. Boxplot of “Print the design” lead time for the mass-customisation process.

The boxplot in Figure 12 below shows the combined effect of the independent variables (i.e. (1) different CMYK ink volumes in the artwork – high, medium, low; (2) dark, medium and light coloured jeans; and (3) new jeans versus used jeans) on total time for the mass customization process. To summarize the observations:

- All but four boxplots are found to have total lead time range of 180 to 190 seconds which indicates that the recorded lead times are similar and that the time range is narrow. Overall range of the total lead time is between 171 and 199 seconds.
- “Dark Used Jeans MC” is the highest situated box on the time axis, with a mean lead time of 192.4 seconds, and the maximum of 199.0 seconds.
- Boxplot for “Medium Used Jeans LC” requires the shortest total lead time (mean = 175.8 seconds, and maximum time of 184 seconds).

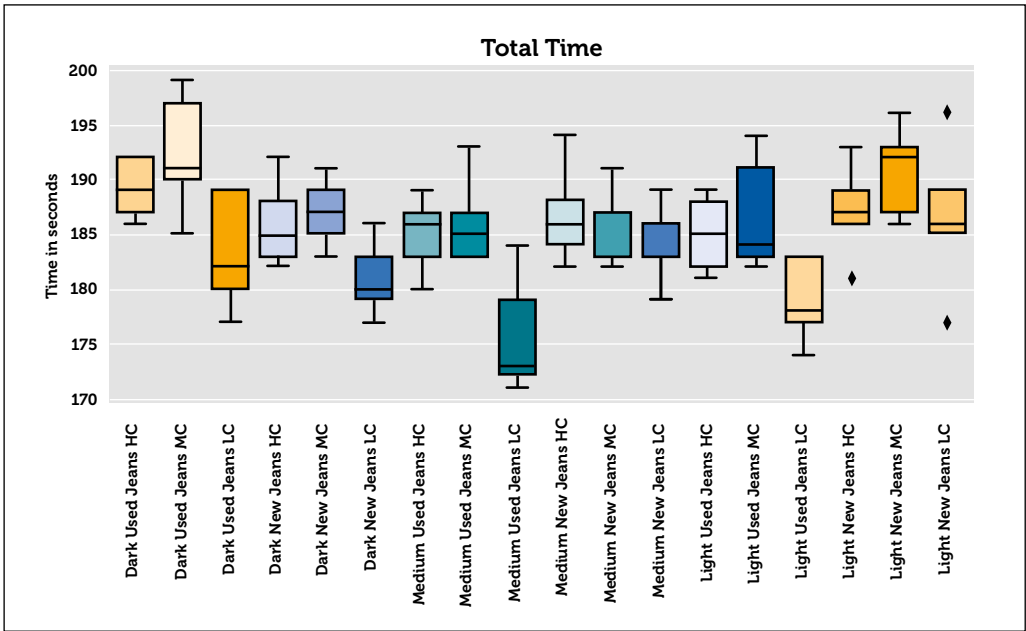


Figure 12. Boxplot of the total time the mass customization process took for different artworks.

Material usage

The model Kimomo from Monki's denim collection was chosen for the pilot study for calculation of costs, as the pocket size for all of the brand's jeans remains constant regardless of the model (see Figure 13).

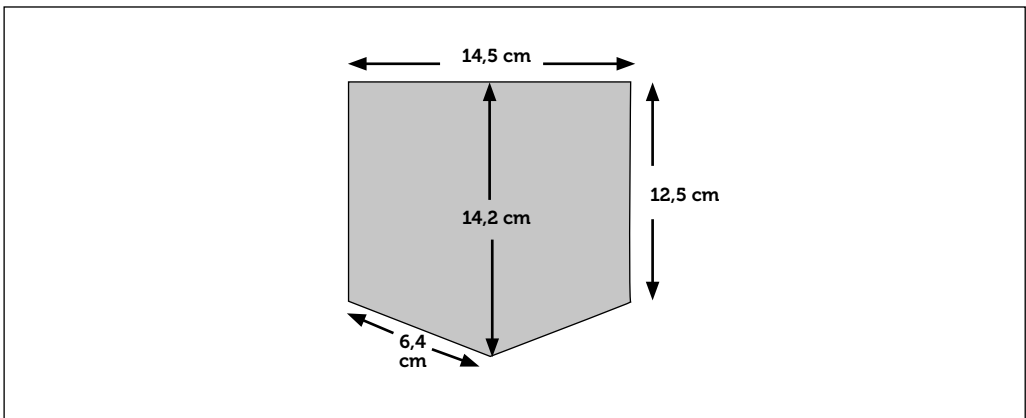


Figure 13. Pocket size of the Monki Kimomo model used in testing.

In order to calculate the cost of printing the pockets for each conducted experiment, the volume of coloured and white inks consumed (based on Brother GTX 4 graphics lab file readings) were exported, together with the amount of pre-treatment used. The consumption of white and coloured inks differed for each experiment, while the pre-treatment amount remained constant (~30ml/ 3.14 kr per print). The cost per cc of white ink was 3.38 kr. Note that there is no equation in the printer manual showing by how much white ink the different mask

settings increase/decrease. The amount of colour used in artwork, is defined by volume of CMYK ink needed for printing, which is 3.2 kr per cc. It is also attributed three levels which can be described as artwork with vibrant colours distinguished by the highest use of CMYK (0.38 cc), a second with fewer colours thus needing less CMYK (0.27cc) and the last artwork with the lowest amount of colour usage (0.12 cc). This is one of the most critical variables affecting the total cost, hence deciding the economic feasibility of the project. The ink consumption was therefore thoroughly tested in different printing scenarios, with three coloured jeans (dark, medium and light) and three types of CMYK levels (high, medium, and low).

Figure 14 illustrates the cost in SEK for the three colours of jeans tested, each in combination with the three types of artwork coloration or CMYK levels. The total cost of the prints depends upon three variables; CMYK, white ink, and pre-treatment fluid consumption. The highest quantity of white ink consumed (3.16 cc) is associated with printing a medium coloured artwork on a dark pair of jeans, resulting in the highest total printing cost (14.68 kr). Printing a bright coloured artwork on light jeans, with only 0.91 cc of white ink consumed, results in the lowest total printing cost (6.60 kr). To summarize the observations:

- All artworks low in CMYK result in low white ink consumption, therefore, leading to the lowest printing cost. Medium CMYK artworks incurred the highest amounts of white ink, and the highest printing cost subsequently.
- The total white ink expenditure cannot be controlled by adjusting the mask levels only, but is assigned to artworks by the Graphics Lab software.
- The total printing cost is directly proportional to the overall quantity of ink consumed during the printing process.
- White ink consumption can be considered an essential component of the total printing cost, and is also slightly more expensive than CMYK. It is, however, impossible to qualitatively predict the total contents of the white ink in an artwork. The output thereof, using the Graphics Lab software, has to be considered if exact quantities of white ink used are essential for the artwork decision making process.

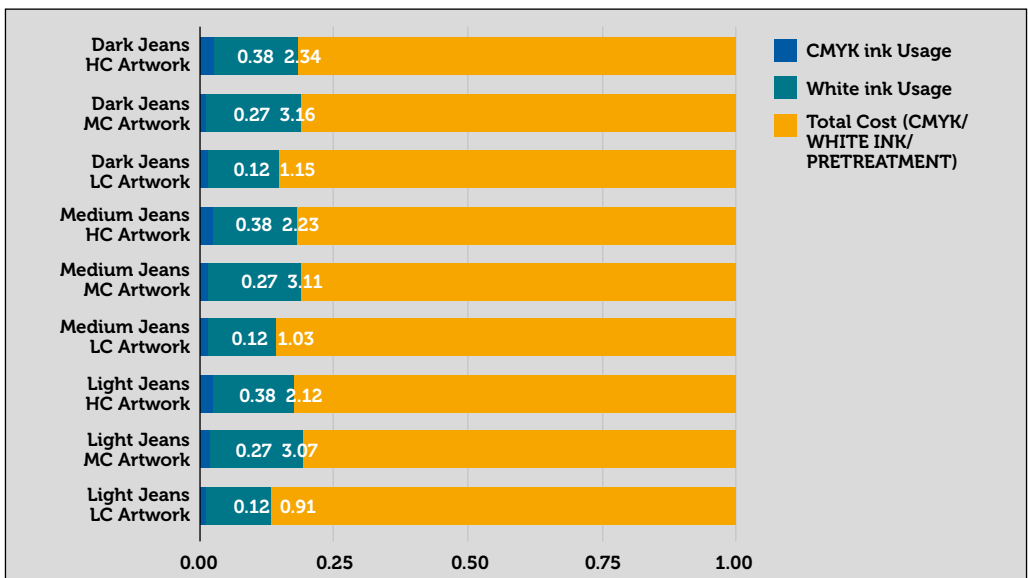


Figure 14. Total material costs for printing (pre-treatment fluid and ink) for the different variables.

5.3.2 Consumer engagement

The mock-up retail setting and configurator were tested during the Fashion Days at the Swedish School of Textiles in May and June 2018, with 40 test subjects as potential customers testing the developed PSS (see Figure 15 below). The configurator guided the customers to customise a jeans pocket with previously prepared artworks from local artists. In return, the customers were asked to fill in a questionnaire with closed-end questions focused on their experience and satisfaction with such service for extending the life time of their garments.



Figure 15. Mock-up retail setting, configurator and test subjects.

The questionnaire was categorised into six variables: (1) demographics, (2) fashion interest; (3) satisfaction with the experience; (4) satisfaction with the product choice (incl. willingness to pay); (5) design for circularity; (6) PSS as brand strengthening. While the overall results of the questionnaire will be presented below, the test subjects unanimously referred to the experience as very positive, and described the configurator as well as the service offered as “exciting” and “fun”.

The research conducted for the Monki case resulted in an in-store event called Re:love, where customers could customise their own or new garments (see Figure 16 below). The events were held in the brand’s flagship stores in Gothenburg and Stockholm over the course of four days in September 2018. An e-invite as well as a Facebook event led to an online interest of 550 people for the two events. In reality this generated a steady stream of customers in-store for the event, a little less than half of the customers brought in an old garment to customise.



Figure 16. Images from the Re:love events.

A prototype configurator on two iPad's were available to the customers where they could visualise and choose artwork stickers to be printed. Many customers were undecided of what prints to choose for their garments and were asking for advice and suggestions from the staff. The customers also asked about the potential to bring in their own artwork to print as well as showed great interest and engagement in the printing process. The customers were asked to answer a short customer survey in return for the free printing event. The result of the customer survey was very positive and the customers unanimously enjoyed the product extension service. The evaluation of the project brought forward that the customisation took longer time than expected but was needed for a better result and was highly appreciated, creating a closer dialogue with customer and a feeling of unique and personal garment. The event created a lot of interest in the store and many customers stayed around just to see the process even if they were not customising a garment themselves.

5.3.3 Consumer acceptance

The previously described events held during the Fashion Days and at the Monki flagship stores were according to the customer questionnaires very well received. Not only were they interested in the product they were invited to co-design but they often showed great interest in seeing the process, and getting involved with the actual printer. The customers were very positive to the experience as a whole, and keen to explore the possibility to take it a step further and use their own designs.

To understand the value of the service offered, and the customers' interest in further pursuing such services, they customers were asked, among other aspects, regarding their willingness to pay for the direct-to-garment printing service (see Figure 17). Furthermore, the questionnaire focused on whether the customers would bring their jeans to the store to get them customised, and if they would then hold on to them longer (see Figure 18 below). As seen on the figure below, most customers (42%) are willing to pay between 50-100 kr for this service, following with 38% willing to pay more than 100 kr.

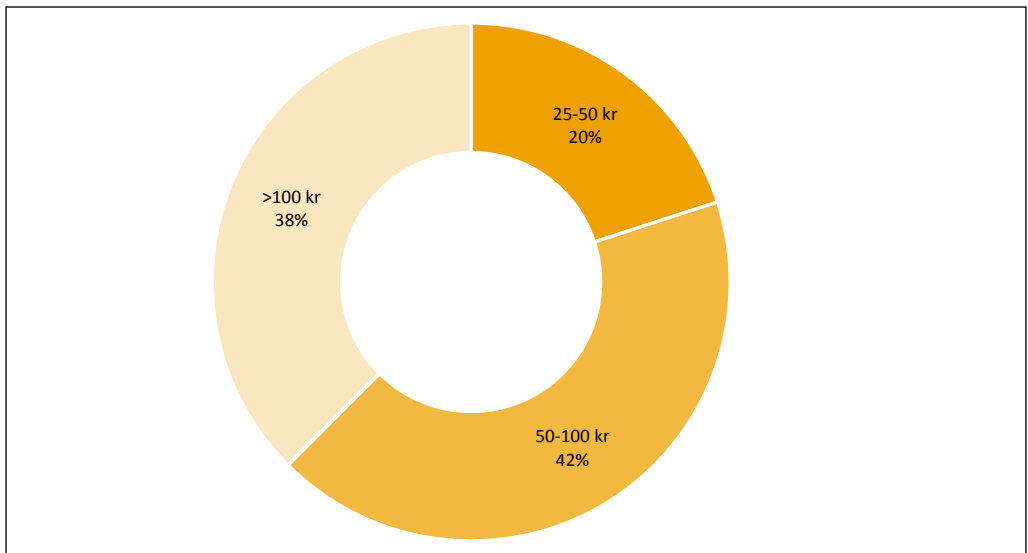


Figure 17. What would be the maximum amount of money you would be willing to spend on a customisation service like this? (Ertelt, Guzun, Scott 2018).

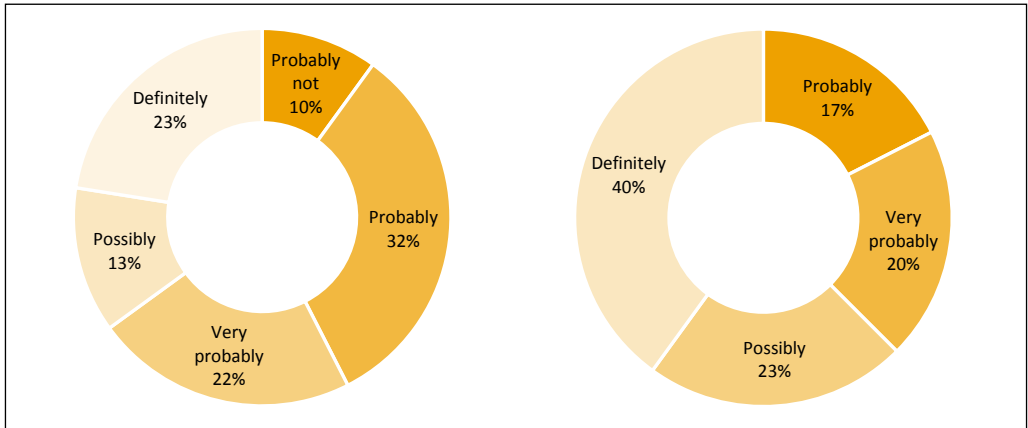


Figure 18. Left: How likely would you bring in old jeans to get them customised?. Right: Based on your experience today do you believe customising your jeans will make you hold on to them longer? (Ertelt, Guzun, Scott 2019).

The data derived from the survey could sometimes be regarded as incidental and hypothetical, nevertheless the data can highlight tendencies and attitudes towards a certain concept. The two above questions are examples of that, and thus the survey utilises the wording “likely” and “believe” in order to show the limitation to the inferences from such data. Albeit, when the data is clearly representing a tendency, as in both cases above but even more so in the second question, its implications should be acknowledged. When asked, “Based on your experience today, do you believe customising your jeans will make you hold on to them longer?” all of the respondents gave an affirmative answer and 40% of the respondents answered “Definitely”.

6. Economic feasibility

6.1 Model description

The economic feasibility of PSS depends on the service processing costs and market price of the service, in this study meaning the price for the customer of renting a garment and printing on a garment. Feasibility is determined by viability of the processing costs depending upon what economic margin of operability a scenario presents when taking into account the cost of materials, products, how often the service is provided etc. The financial model followed in this report is “Leeway for process cost”, developed by Re:textile¹⁷, and is adapted accordingly to the nature of both cases presented. The next sections focus on outlining the cost drivers and likely costs and prices of servitization based on the two cases presented, which are of interest to fashion brands and retailers by understanding the economic feasibility of such circular business models.

6.2 Financial model for Case I

For Case I, the developed scenarios are based on different possibilities for updating and expanding the Rental concept by collaborating with a range of potential partners, such as the previously described hotels and multi-brand retailers. The scenarios are designed to be uniform, meaning that they can be applicable to different types of partners, while details that

¹⁷ Re:textile – Feasibility of Fashion Remanufacturing (2018)

are more specific are not described in the study, as they are assumed to be partner-oriented and dependent on the specific agreements.

6.2.1 Scenario development

The primary variables for the scenarios are ownership, handling and washing costs, time period offers, how many times rented by the customer, and how the revenue from renting is shared. Depending on the ownership Houdini is in charge of the landed price for the garments (i.e. cost of the garments when they reach Houdini's central warehouse), or the garments are purchased by the partner. Furthermore, ownership affects aspects such as the quality of the service depending on how much control Houdini has over the concept, and scalability of expanding the concept, which would be facilitated by working with an external partner at already established locations, customers and facilities.

Handling and washing of the garments is assumed to be carried out by and with costs covered by the partner in most scenarios, as it will facilitate offering the service and decrease costs and environmental impact by not transporting the garments between the rental periods. Furthermore, the cost of handling and washing the garments is assumed to be at the same level as in the Houdini store – i.e. 10 kr for handling and 20 kr for washing per garment, besides the scenarios where the garments are assumed to be rented online through Houdini's own warehouse and a 3PL partner.

While it can be assumed that hotels have their own systems in place for cleaning the garments, it is presumed that the same applies for the multi-brand retailers – either by already having the system in place or by installing it based on the agreement between Houdini and the partner. Whether or not Houdini owns the garments, additional services are assumed to be included for the partner, such as repairs and monthly quality control of the service as is agreed upon with the collaboration with Copperhill. As those costs depend on the level of service agreed upon and the necessity for repairs, they are not included in the calculations.

Thus, the critical success factors and considerations for Case I scenarios are (not all are applicable to all scenarios):

- Basis for all scenarios is a men's set of a jacket and pants
 - Landed price (confidential)
 - Wholesale price (confidential)
- Cost of handling and washing 30 kr/piece (incl. estimation of direct labour cost and washing cost) for Houdini and partner, 40 kr/piece for customer-owned
- Ownership of the garments
 - Houdini
 - Partner (e.g. hotel or multi-brand retailer)
 - Customer (peer-to-peer rental facilitated by Houdini)
- Number of times rented/set
- Rental period offers
- Overhead costs are not included in the calculations due to unavailability of data

In most scenarios the one-week period has been taken as a focus point for calculating feasibility due to being the most popular period for the customers. Furthermore, the calculations are specific to one men's Candid set, as renting a set has also proven to be most popular (see Figure 4 above). As noted above, overhead costs are not included in the calculations due

to unavailability of data. However, overhead costs should be taken into account when assessing economic feasibility of such servitization business models, as in this case the feasibility is assessed based on the gross profit indicating the Leeway for product and processing costs.

Scenarios 1-3

Scenarios 1, 2 and 3 (Table 2) entail Houdini's ownership of the garments, with the cost of handling and washing being assumed at 30 kr/piece, thus 60 kr/set for one rental. The number of times rented per set are assumed at one, three and five times per set. The scenarios act as baseline scenarios for Houdini as the stores are the brand's central location for renting their garments, with prices for the customer defined at 525 kr, 700 kr and 1400 kr per set for 1-day, 3-day and 7-day period offers.

Scenarios 4-5

Scenarios 4 and 5 (Table 3) entail Houdini's ownership of the garments, with the rental service offered to customers online through the brand's own website. Additionally, the scenario assumes that handling, washing and logistics of the garments is carried out by Houdini's own warehouse or a 3rd party logistics provider based in different hubs over the country, similarly to previously described potential partnerships with hotels and multi-brand retailers. Based on those assumptions and other scenarios, it is estimated that the handling costs are higher due to increased workload due to shipping at an estimated 30 SEK/piece at Houdini's warehouse along with washing for 20 SEK/piece, and approximately 14.3 SEK/piece¹⁸ for handling, washing and distribution at a 3rd party logistics provider. Furthermore, while distribution costs are included in the total cost by the 3rd party logistics provider, the costs for Houdini sending and receiving the garments in their own warehouse add up to an estimation of 50 SEK/piece¹⁹.

Scenarios 6-8

Scenario 6 (Table 4) assumes Houdini's ownership of the garments, with the rental services offered through a partner, such as a hotel or multi-brand retailer, with the rental revenue shared 50-50 between the partners. While ownership remains to Houdini, the partner will take care of handling and washing, at a total cost of 30 SEK/piece, as described above. With the cost of handling and washing assumed to be deducted from the partner's revenue, the Leeway for processing costs is calculated for the partner. Furthermore, as Houdini is responsible for the cost of the garments at the landed price, the brand's Leeway is calculated for costs related to additional services to the partner, as described above.

Scenario 7 (Table 4) assumes the partner's ownership of the garments, while the rental revenue is shared 30-70 for the partner's advantage. This type of agreement, similarly to a franchise business model, enables Houdini to remain in control of the service and its quality, while also offering service and repairs to the partner free of cost. In contrast to the previous scenario, the partner is responsible for the cost of the garments, at the wholesale price. This concludes another revenue for Houdini from the sale, contributing to their Leeway related to additional services to the partner. However, the Leeway is presented for the partner as they are responsible for the handling and washing costs.

¹⁸ Information from a 3rd party logistics provider working with subscription service of garments

¹⁹ Overhead costs are not included in the calculations

Scenario 8 (Table 4) assumes the customer's ownership of the garments, with a focus on a peer-to-peer rental service facilitated by the brand's own stores. The handling and washing costs are assumed to be higher for this scenario at 40 kr/piece due to more focus on single customers willing to rent their garments. While costlier, such service enables an additional revenue for Houdini, while prolonging and strengthening the brand-customer relationship, and further demonstrating the brand's garments' high quality and sustainability.

	Scenario 1 1-day period			Scenario 2 3-day period			Scenario 3 7-day period		
	1	3	5	1	3	5	1	3	5
Nr. of times rented	*	*	*	*	*	*	*	*	*
Landed price	*	*	*	*	*	*	*	*	*
Handling and washing costs	60 kr	180 kr	300 kr	60 kr	180 kr	300 kr	60 kr	180 kr	300 kr
Rental price	525 kr	525 kr	525 kr	700 kr	700 kr	700 kr	1 400 kr	1 400 kr	1 400 kr
Rental revenue	420 kr	1 260 kr	2 100 kr	560 kr	1 680 kr	2 800 kr	1 120 kr	3 360 kr	5 600 kr
Leeway for handling and washing costs	-1 206 kr	-366 kr	474 kr	-1 066 kr	54 kr	1 174 kr	-506 kr	1 734 kr	3 974 kr
Economic feasibility	Not feasible	Not feasible	Feasible	Not feasible	Not feasible	Feasible	Not feasible	Feasible	Feasible

Table 2. Scenarios 1-3 for Case I (*confidential).

	Scenario 4 Houdini warehouse			Scenario 5 3PL		
	1	3	5	1	3	5
Nr. of times rented	*	*	*	*	*	*
Landed price	*	*	*	*	*	*
Handling and washing costs	200 kr	600 kr	1 000 kr	28 kr	84 kr	140 kr
Rental price	1 400 kr	1 400 kr	1 400 kr	1 400 kr	1 400 kr	1 400 kr
Rental revenue	1 120 kr	3 360 kr	5 600 kr	1 120 kr	3 360 kr	5 600 kr
Leeway for handling and washing costs	-506 kr	1 734 kr	3 974 kr	-506 kr	1 734 kr	3 974 kr
Economic feasibility	Not feasible	Feasible	Feasible	Not feasible	Feasible	Feasible

Table 3. Scenarios 4-5 for Case I (*confidential).

	Scenario 6 Partnership, Houdini-owned			Scenario 7 Partnership, partner-owned			Scenario 8 Partnership, customer-owned		
	1	3	5	1	3	5	1	3	5
Nr. of times rented	*	*	*	*	*	*	*	*	*
Landed/wholesale price	*	*	*	*	*	*	*	*	*
Handling and washing costs	60 kr	180 kr	300 kr	60 kr	180 kr	300 kr	80 kr	240 kr	400 kr
Rental price	1 400 kr	1 400 kr	1 400 kr	1 400 kr	1 400 kr	1 400 kr	1 400 kr	1 400 kr	1 400 kr
Rental revenue Houdini	560 kr	1 680 kr	2 800 kr	336 kr	1 008 kr	1 680 kr	560 kr	1 680 kr	2 800 kr
Rental revenue partner	560 kr	1 680 kr	2 800 kr	784 kr	2 352 kr	3 920 kr	560 kr	1 680 kr	2 800 kr
Leeway for handling and washing costs	560 kr	1 680 kr	2 800 kr	-2 536 kr	-968 kr	600 kr	560 kr	1 680 kr	2 800 kr
Economic feasibility	Feasible	Feasible	Feasible	Not feasible	Not feasible	Feasible	Feasible	Feasible	Feasible

Table 4. Scenarios 6-8 for Case I (*confidential).

6.3 Financial model for Case II

For Case II, the scenarios are based on the in-store PSS model, where the individual customer walks into the store, either with an old pair of jeans or aiming to buy a new pair, with the wish to redesign that piece of garment to add own creativity to it. The data used for the financial model was gathered during the pre-testing and testing of the configurator with 40 customers during the Fashion Days in Borås, as described above.

In the described case, the customers were only allowed to redesign their Monki jeans as the artworks were earlier experimented for ink type, processes, resolution, etc. only on uni-sized Monki jeans pockets, pre-determined colours and material composition. Regardless, it is entirely feasible to adapt the fast, direct-to-garment printing process to any type of jeans or even other types of garments from other brands. However, as these factors will have different

impacts on the amount and type of inks required, the treatment time, etc., they will accordingly will influence the process costs.

6.3.1 Scenario development

The main variables for the scenarios of Case II are:

Direct process costs

- Material costs
- Labour costs

Overhead costs

- Labour costs
- Printer maintenance costs
- Printer monthly lease payments
- Location (store) monthly rent payments

Customers' willingness to pay

- Based on customer questionnaires collected during the Fashion Days

The direct process costs entail total printing material costs, based on the use of CMYK in, white ink and pre-treatment materials. The cost of those materials depends on the colour of the jeans, the volume of ink used based on the chosen artwork, and whether the jeans are new or used. The total direct material costs for printing were estimated to be in the range of 6.60 to 14.68 kr per piece. Further direct costs are related to labour, which are based on an estimation of the salary costs involving a co-design assistant within the store. As defined above, the overall total lead time for printing on a pair of jeans ranges between 171 and 199 seconds. An approximate of 7 kr per minute is considered as a multiplying factor²⁰.

The overhead costs are firstly allocated to labour costs, which in this case are assumed to be 50%²⁰. Overhead costs are also estimated for maintenance of the printer per garment, which according to the Brother DTG ROI calculator²¹ are at 25% of direct cost for ink per print. Included here are also the month lease payment for the GTX4 printer²² and the Pretreatmaker²³, with both at USD799 per month. For a time period of 24 months, the printer cost adds up to an approximate 7 200 kr/month and 1 000 kr/month for the Pretreatmaker, which is evaluated at the same ratio as the printer.

Further overhead cost relate to rental prices for the location, which in this case are calculated based on the city average and maximum prices in Stockholm for 2 200 kr/m²/year and 23 000 kr/m²/year. As the PSS set-up requires approximately 10 m² within the store, and assuming a medium-high rent of 18 000 kr/m²/year (i.e. 1 500 kr/m²/month), the total rent costs are estimated to be 15 000 kr/month.

Customer willingness to pay is based on 40 customers that participated in the tests estimating the value of the offered customised service. As previously described, the customers were asked to state a price range they were willing to pay for the redesign service. The estimations are detailed below.

²⁰ as calculated for Case 2 in Re: textile – Feasibility of Fashion Remanufacturing (2018)

²¹ <http://brotherdtg.com/about-the-gtx/roi-calculator/>

²² <http://brotherdtg.com/about-the-gtx/roi-calculator/> (GTX4 USD22,500 paid in full)

²³ <https://www.stormtextil.dk/en/machine-sales/schulze-pretreatmaker-iv> (Price = 2700 EUR)

- no respondent valued the service under 25 kr
- 8 respondents (20%) were willing to pay between 25-50 kr
- 17 respondents (42,5%) were willing to pay between 50-100 kr
- 15 respondents would consider paying more than 100 kr

Further considerations are based on the assumptions of volumes (i.e. how many prints can be feasibly sold to the customer as a service, based on the minimum and maximum total lead times).

- Minimum capacity (M) = (20 days/month x8 hours/day x 3600) /199 seconds/print = 2894 prints/month.
- Maximum capacity (M) = (20 days/month x8 hours/day x 3600) /171 seconds/print = 3368 prints/month.

Based upon the above considerations, two simple scenarios have been developed based on the minimum and maximum cost estimates (see Figures X and X below).

- Scenario 1 (Table 5). The redesign as a service is offered at three customer willingness to pay (minimum, middle, maximum) at maximum cost estimates.
- Scenario 2 (Table 6). The redesign as a service is offered at three customer willingness to pay (minimum, middle, maximum) at minimum cost estimates.

Scenario 1			
Denim re-design as a service			
Customer willingness to pay (kr/pc)	25 kr	50 kr	100 kr
Max. direct print costs (kr/pc)	15 kr	15 kr	15 kr
Max. direct labour costs (kr/pc)	23 kr	23 kr	23 kr
Max. labour cost overhead (kr/pc)	12 kr	12 kr	12 kr
Max. maintenance cost overhead (kr/pc)	4 kr	4 kr	4 kr
Monthly lease payment (kr/pc)	3 kr	3 kr	3 kr
Monthly rent payment (kr/pc)	5 kr	5 kr	5 kr
Cost-Benefit	-36 kr	-11 kr	39 kr
Economic feasibility	Not feasible	Not feasible	Feasible

Table 5. Scenario 1 for Case II.

Scenario 2			
Denim re-design as a service			
Customer willingness to pay (kr/pc)	25 kr	50 kr	100 kr
Max. direct print costs (kr/pc)	7 kr	7 kr	7 kr
Max. direct labour costs (kr/pc)	20 kr	20 kr	20 kr
Max. labour cost overhead (kr/pc)	10 kr	10 kr	10 kr
Max. maintenance cost overhead (kr/pc)	2 kr	2 kr	2 kr
Monthly lease payment (kr/pc)	2 kr	2 kr	2 kr
Monthly rent payment (kr/pc)	4 kr	4 kr	4 kr
Cost-Benefit	-20 kr	5 kr	55 kr
Economic feasibility	Not feasible	Not feasible	Feasible

Table 6. Scenario 2 for Case II.

Under the assumed conditions, redesign as a service is clearly feasible in most cases, except when the customer willingness to pay is the least and the costs are the highest. There is of course a substantial uncertainty associated with the calculations, due to the experimental nature of the case.

7. Servitization business models

According to Osterwalder and Pigneur (2010), "a business model describes the rationale of how an organisation creates, delivers and captures value". Thus, a business model is composed of three basic elements: value creation, value architecture and revenue structure. For servitization business models value proposition and customer segments are most relevant to focus for value creation. Value is created through customer relationships, as with PSS the customer experience is relevant to focus on, with further value creation taking place through distribution channels, key resources and activities, and partners. The value is captured through the cost structure and revenue streams. For Case I, the business model is focused on the current rental model with suggested updates and new partnerships for scaling up, while for Case II the business model is adjusted due to its experimental nature to a proposal for also scaling it up.

7.1 Business Model Canvas – Case I

The business model canvas for Case I, focusing on Houdini Sportswear's rental business model, is designed based on the previously presented results related to the five core elements to garment rental, and interviews carried out with relevant stakeholders within the company and their current partner. The proposed business model canvas is presented on Figure 19.

Value Propositions: the value propositions are indicated based on the current offer and proposed suggestions for updating and expanding the business model. By offering the brand's garments for rent, customers gain access to the garments at affordable price points, at which higher levels of product satisfaction are expected due to the customers accessing durable products, and having the opportunity to try the garments out before making a decision to purchase.

Customer Segment: The Houdini core customer segment is continuously targeted, while further focus should be assigned to environmentally and trend conscious consumers who see the environmental benefits in not owning the garments, or due to wanting to try out different styles and colours. Furthermore, the study indicates further focus on athletes and families with children, due to their changing needs and preferences.

Customer Relationships: The implementation of PSS is strengthened through a social/brand community, where customer experience is engaging through the brand encouraging and facilitating the customers' access to their garments and thus to nature. Through such service and a further opportunity for customers to rent their own garments, the relationship becomes collaborative and value is co-created through prolonged and strengthened communication.

Distribution Channels: Due to the garments being the main resource for the rental service, it facilitates offering the servitization business model through online platforms and different partners, with already established systems for handling, washing and delivery, which also is not estimated to be costly to set up if not established.

Key Partners: With an already established relationship with a hotel, further partnerships are encouraged to be established with hotels and multi-brand retailers for expanding the rental business model. Furthermore, to be able to reach more customer segments, the study

proposes offering the service in-store with peer-to-peer renting, through online platforms such as Tradera or Sellpy, and additional environmentally friendly delivery options, such as Move by Bike. To further facilitate the service, additional partners such as laundry service providers can be of interest.

Key Activities: The new value proposition lead strengthening the brand’s current value propositions, through marketing and communicating the rental service in order to reach more customers. Furthermore, a focus should be on establishing and strengthening new partnerships, while data analysis is relevant to target to optimise future rental collections.

Key Resources: Regarding key resources, the brand has already established market position and the rental business model, along with existing partnerships that should be complemented with new partnerships.

Cost Structure: The costs entail directly the production costs of the garments, while also including costs related to offering the service, mainly handling, washing, delivery and labour costs.

Revenue Streams: The revenue streams are similar to the existing ones, through online or physical store rental sales, with further streams through a variety of partnerships.

Figure 19. Proposed servitization business model for Houdini Sportswear.

<p>Key Partners Hotels (e.g. Copperhill Mountain Lodge, Scandic Hotel Group, Nordic Choice Hotels) Multi-brand retailers (e.g. Naturkompaniet) Customers (peer-to-peer rental in-store) C2C online platforms (e.g. Tradera, Sellpy) 3PL Delivery (e.g. Move by Bike) Laundry service (e.g. Washypop)</p>	<p>Key Activities Marketing and communication Establish and strengthen new partnerships Data analysis informing new collections</p>	<p>Customer Value Propositions Access to the brand's garments Affordable price points Higher levels of product satisfaction Durable products</p>	<p>Customer Relationships Social/brand community Collaborative Engaging experience Value co-creation Prolonged and strengthened</p>	<p>Customer Segments Existing Houdini target customers Environmentally conscious consumer Trend conscious consumer Athletes Families with children</p>
<p>Key Resources Established brand/market position Established rental business model Established partnerships</p>			<p>Distribution Channels Houdini stores Houdini online store Houdini social media Hotel receptions Multi-brand retailers C2C online platforms</p>	
<p>Cost Structure Garment acquisition cost Handling, washing and delivery costs Labour costs</p>		<p>Revenue Streams and Pricing Increased sales through own channels Existing and new partnerships</p>		

7.2 Business Model Canvas – Case II

Due to the experimental nature of Case II, an initial or wished business model canvas was designed at the beginning of the project during a meeting between Monki and Re:textile. Implications of the project on the brand’s existing business model and value chain were

discussed. A servitization business model was envisioned as follows:

- Value Proposition - The value for the customer is twofold, both the experience and the product of the co-creation.
- Customer Segments - Monki customer core is political/indie. An on trend customer, brand-unloyal or not yet convinced is the hoped extension.
- Customer Relationship - How to scale the co-creation, what makes a repeat customer?
- Incremental print designs, collaborations with artists.
- Distribution Channels - IGC, UGC, physical stores, festivals and Pop Up. Monki consumers engage in sharing.
- Key Partners - Re:textile, Brother, ACG Nyström are the key partners. Berge Consulting, PR- agencies, Event coordinators and Monki Ambassadors will also be seen as partners.
- Key Activities - Activate IGC (influencer generated content) and UGC (user generated content). Create an Activity and Communications plan. Artwork need to be sourced or designed as well as paid for.
- Key Resources - The Monki brand. Being established already means having a market, de-signer, collaborations, purchase and logistics departments and trained staff at hand. Extra re-sources will be printers and machines specific for the customization activity.
- Revenue Stream - 50 SEK per print and 250 SEK for a limited edition print. Prints could be used instead of gift vouchers.

Based upon the above business planning, and after developing and testing the servitization business model by utilizing direct-to-garment printer to mass-customise in-store, a revised Business Model Canvas was proposed (Figure 20).

Value Propositions: The study indicates several possible additions to the value proposition segment relating to the end product, service extension and customer experience. The customer discourse of the customization experience was positive with expressions such as 'unique', 'surprising' and 'fun' being used. The customers showed great interest in, and willingness to engage with, the customization process. They also shared their designs via social online networks which indicate that the customers accredit a certain value to the product derived from the product extension service. During the configuration process customers were interested in the origin of the artwork, which indicates that artification could be used as another value proposition. Majority of customers showed high levels of product satisfaction, willingness to engage in similar activities, as well as pay a premium price for the service.

Customer Segment: The Monki core customer profile is extended with the individualistic, environmentally conscious and trend sensitive consumers. Even though some of these characteristics are included already in the existing customer base, there is value in defining and targeting them separately. The individualistic consumer has a high tendency to engage in the product extension service whilst the notion of circularity and product life extension attracts the environmentally conscious customer. More and more brands are engaging in co-creation and collaborations, constantly bringing new trends to the surface, which could serve to attract the trend sensitive consumers as well.

Customer Relationships: The implementation of a product service extension has the potential to contribute in building a strong customer to brand relationship. There are several touch points that allow customer interaction in the developed PSS, the product, the service/experience and the social/brand community touch point. Value propositions could be added at each of these touch points as well as that there is an opportunity for brand enhancement.

Distribution Channels: Mobile equipment like the direct-to-garment printer enables several channels for the PSS such as retail stores, pop-up stores, events or any other situation where the machines could be set up according to the operating specifics.

Key Partners: Most of the key partners stayed the same with the addition of engaging illustrators, as well as artists for the project. Based upon the customers' keen interest in the design process, it is advisory to explore the possibility of increased perceived product value, as well as brand equity through the collaboration with designers and illustrators. The collaborations can strengthen the bond between the customer and the product which hold the potential to enhance the emotional durability and extending the use phase of the product.

Key Activities: The new value proposition lead to an implementation of several new activities such as creating a printer workspace, training co-creation staff, develop a full capability configurator, activate a brand community sharing and creating a soft launch plan.

In order for the direct-to-garment printer to function optimally it needs a climate controlled room with at least 35% humidity, but for shorter periods, and with increased maintenance, it can function in a less optimal environment. The staff will need training to handle the technological aspects such as the configurator, the printer software, the printer itself, the pre-treater as well as the heat press. Since the staff will need to be able to guide the customer through both the decision and design process utilizing the configurator, the staff will need to be comfortable with the advisory role.

Furthermore, a fully integrated configurator need to be created and tested, to make sure it is all compatible with the printer software, whilst offering a simplistic interface to the customers. The Monki customer has been described as happy to share their content online, which indicated the importance of offering a platform for sharing their co-creation experiences as well as their finished designs. The community sharing of the new technology and servitization could have the added benefit of reducing the burden of choice and speed up the decision-making process for the individual consumer. Since the plan is for the proposed product extension service to roll out live in Monki stores and so far only has been tested in a mock-up environment, it is advisory to create a soft launch plan where it is implemented in one or two stores and then re-evaluated before the hard launch.

Key Resources: The additional key resources that were identified during the pilot testing were the need of a service technician as well as an integrated product platform. The printer performs on an optimal level when maintained continuously and the mechanical requirements are larger than first anticipated. To be able to train staff in the customer-related aspects and quickly be able to implement the PSS activity it is advisory to have a technician tied to the project as well. By offering an integrated product platform that merges the product extension service into Monki's omnichannel and social media presence, the customers' opportunities to engage and share their experiences are maximized.

Cost Structure: There are some costs directly related to the activity such as acquiring the printer (lease, rent or purchase), product configurator development, co-creation staff training, artwork, and the printer workspace.

Revenue Streams: The streams are similar to the existing ones, online or physical store sales, though events and pop-up activities could pose as additions. The recommendation, based on the findings of the project, is to employ a value based pricing strategy as opposed to a cost based strategy since there is a strong willingness from the customer’s perspective to pay for the service.

Key Partners Monki Re:textile Brother/ACG IT consultancy Illustrators and artists PR agencies	Key Activities Create printer workspace Train co-creation staff Create fully functioning product configurator Source final prints Activate brand community sharing Soft launch plan Marketing and communication	Customer Value Propositions Collaborative customisation experience Artification and craft consumption Higher levels of product satisfaction Emotionally durable products Affordable price point	Customer Relationships Collaborative Engaging experience Value co-creation Social/brand community	Customer Segments Existing Monki target customers Environmentally conscious consumer Individualistic consumer Trend conscious consumer
	Key Resources Established brand/market position Direct to garment printer Co-creation staff Service technician Integrated project platform Design collaborations		Distribution Channels Flagship stores/pop-ups Monki social media channels	
Cost Structure Printer leasing Product configurator development cost Staff training/labour cost Print acquisition cost Printer work space cost		Revenue Streams and Pricing Store/pop-up print sales Increased sales		

Figure 20. Proposed servitization business model for Monki.

8. Discussion and conclusion

The textile and fashion industry currently operates a linear take-make-dispose model where large amounts of non-renewable resources are used to produce garments, which are discarded by consumers at ever increasing rates, ending in either landfill or incineration plants. The phenomenon of clothing underutilisation is incentivised by the high availability, affordability, as well as the low quality of garments produced in the fast fashion segment. The fast fashion operating model is the industry predominant, characterized by short lifecycle, trend-based designs, frequent replenishment, and large-scale production (Pal 2016). Creating circularity through servitization in the textile and fashion industry business models addresses the clothing underutilisation.

The strengths of of servitization business models are their capacity to reduce environmental footprint when used to minimise new consumption, as well as prolonging the garments’ life expectancy. Also, an alternative business model concept employing a form of servitization where used garments are redesigned or upgraded, like in the Monki case by printing on them, aims to reduce the dependency on natural resources as well as at the same time strive for improved product longevity (Pal 2016).

By creating new value flows and business strategies, competitive advantage is created through optimisation and value recovery of already existing resources. Furthermore, as mentioned above, by creating a strong bond between the brand and the consumer, brand loyalty is strengthened. As the customer is more involved in the processes, and actively participates in the value creation, companies prolong and strengthen their relationships, and first-hand receive valuable information of the customers' needs and wants.

Rental business models, such as the one offered by Houdini, as alternatives to more traditional sales models allow customers to access garments for one-time occasions and short-term needs without increasing demand for new clothing (Ellen MacArthur Foundation 2017). On the other hand, as highlighted by the foundation, businesses benefit from creating new streams of profit while building long-term relationships with their customers. Servitization as it is used in the Monki case could eventually lead to design for circularity, where the end stage for the product is already considered as well as acted on in the design phase. This would enable the users to reinvent their garments instead of discarding them and thus facilitating the servitization even more.

As service innovation often requires new technical and logistic solutions, higher costs can be expected during the initial stages of implementing servitization business models. Such technical advancements also require a customer that is flexible and engaged. Furthermore, when implementing servitization, complexity of the offer adds a risk of overwhelming the customers by offering them too many choices, or making the value chain more complex, thus slower and less profitable.

On the other hand, such servitization business models have the potential to serve as a platform for sustainability aspirations, and raising the issue of overconsumption. By making use of the information the companies engaging in servitization are expected to receive, they are able to better predict what the customers' needs are, or to tap into a gap in the market. A significant potential contribution to sustainability is the move towards a pull value chain (as opposed to a push value chain) that mass customisation could offer by having the customer involved in the design stage.

Since there are clear indications in research that society is becoming more and more individualistic one can argue that the target audience for servitization is very broad. In order to tailor the servitization to the customer group that is being targeted it is imperative, like in all business ventures, know your customer well. During the course of the two cases in this report, several potential customer groups were defined: (1) the informed customer who is interested in the concept of sharing economy; (2) the environmentally conscious customer who recognises servitization as a means to extend garments' life cycle; (3) the technologically advanced customer who is driven mostly by the process itself; and (4) the individualist who cannot find what they truly desire in the regular offer, but enjoys adding services to tangible products.

Relevant markets for servitization strategies are, amongst others, fashion and home textile as well as their potential collaborators along the value chain. Servitization can be implemented in all business models but companies engaged in incremental or modular design with an agile value chain, could facilitate the servitization activity easier. Companies seeking to expand their offering with a service could benefit from looking into different servitization strategies, where renting, leasing, co-design and collaborations are potential ventures. Being first to

market with the new technology that is often required when implementing activities of servitization can create a niche or a competitive advantage. Servitization supports a sustainable approach to the fashion loop, and hold the possibility to extend the fashion loop and thus also the garments lifecycles. Another benefit is that by being first you set the rules and by doing so one is able to steer the market in a desirable direction.

8.1 Key decision variables

For Case I, the decision variables are mainly related to key partnerships and activities:

- choice of partnerships and scenarios, relating to distribution channels, cost structures and revenue streams for creating additional value through extended producer responsibility.
- key activities, relating to how the servitization offer is marketed and communicated to customers, along with establishment of partnerships for expanding the business model nationally in Sweden.

For Case II, the decision variables are mainly related to developing:

- physical front office garment customization solution space/printer workspace. Here the three key process variables are: fabric composition of the garment, colour of the garment (light, medium, dark), and variation of amount of colour used in the artwork for the customization.
- (ii) virtual front office product configurator. Here the key decisions to be taken by the customer with the aid of the co-design assistant are: the colour of the garment, and (ii) the choice of artwork to be printed.

Apart from these, the back-end processes are also crucial to support the decision-making stages front-end.

8.2 Critical success factors

For Case I, the critical success factors for garment rental PSS are identified below:

- Direct service costs: the costs related to handling, washing and delivery of labour, cost per wash per garment, and costs related to shipping.
- Partnership scenarios: to define specifics of each existing and new partnership, while not creating complexity in the value chain, thus leading to increased collaboration and coordination for increased sustainability efforts.
- Customer willingness to pay: to further understand the value of the service to the customer, although the service is already somewhat established.

For Case II, the critical success factors for direct-to-garment mass-customisation PSS are identified below:

- Direct process costs: the total printing material costs, based on use of CMYK ink + white ink + pre-treatment material is dependent upon three aspects: colour of the jeans, volume of ink used per artwork and condition of the jeans (new or used), and needs optimisation.
- Overhead costs: as a large part of the overhead is the leasing cost of the Brother GTX4 printer, the company may benefit from investing in buying the printer. But in that case such PSS must be a long-term strategic consideration by the company, as a drive to move towards circularity.
- Customer willingness to pay: to estimate the value/price of customised redesign service this is critical.

- PSS lead time: the total time for the mass customization process is impacted by the combined effect of the independent variables (i.e. (1) different CMYK ink volumes in the artwork – high, medium, low; (2) dark, medium and light coloured jeans; and (4) new jeans versus used jeans), and needs optimisation.

8.3 Feasibility assessment

Regarding Case I, as the scenarios for expanding are deemed feasible, in terms of whether the ownership of the garments remains to the brand or is transferred to partners, Houdini is able to implement the concept quicker and more flexibly (Ellen MacArthur Foundation 2017), while benefiting from sharing competences and resources (Pal 2016) and remaining in control of the quality of the service. In conclusion, while the suggestions for updating and expanding the Rental business model are deemed economically feasible, they should be reviewed, planned and applied by the brand, and followed by an evaluation of the results. Furthermore, such business model has the potential to decrease the environmental impacts associated with the textile and apparel industry, as the garments are used repeatedly, and less resources are used for producing new garments.

For Case II Under the assumed conditions, redesign as a service is clearly economically feasible in most cases, except when the customer willingness to pay is the least and the costs are the highest. By having complete or partial control of the value-adding service, Monki is able to render higher physical responsibility of a product (Pal 2016). There is of course a substantial uncertainty associated with the calculations, due to the experimental nature of the case. Additionally, such business model contributes to potentially decreasing the environmental impact of the industry, as the through providing redesign as a service, clothing will be utilised more and longer, thus decreasing market demand for new garments.

Scaling up potential

Scaling up activities of servitization could pose as rather complex, unless the business model design allows for it. In the Monki case it would be possible to scale up in terms of creating a concept of the blueprint and the configurator that then could be applicable for several businesses with similar offerings. The pivotal point of scaling up in the Monki case is the initial cost of the printer, which could be offset by utilising the printer for more than just the servitization activity for example using it for their off the shelf printed items. The long term benefit to a broader usage would be that the products could be sold first and printed after sale to reduce the items that become out of date due to print design etc. In terms of the servitization utilized in the Houdini case, the scalability potential lies in initiating collaboration partnerships with suitable hotels and multi-brand retailers. The collaborations would enable the rental service to take advantage of the customer base and networks of those partners.

The results of the combined research all points to the conclusion that it is indeed possible to implement the product service extension successfully. Tests relating to the customer as well as the service provider perspective have proven themselves implementable due to low overall printing costs and fast print time enhancing the customer shopping experience. Together with an indication for product satisfaction as well as creating a strong customer-product connection through the co-design experience it contributes to a circular economy. Furthermore, the overall consistent service costs support the implementation of a PSS in a retail setting for both cases.

8.4 Future considerations and recommendations

As mentioned earlier in this report, Information transparency for extending informative responsibility, raising awareness for extending informative responsibility and platform-enabled networking for extending informative responsibility, are all areas of interest in terms of enabling the implementation of servitization on a broader scale.

In order to anchor these projects in existing business models, full-scale tests need to be conducted and evaluated. After the proposed PSS is implemented at scale, point-of-sale data could be gathered in order to establish the customers' true willingness to participate and engage in the servitization. Additionally, a longitudinal continuation of the study would give answers to some of the indications arising from the Monki study, such as whether the mass customisation could truly serve as a brand strengthening activity or lead to an extended garment lifecycle in reality. In terms of the rental business model, further studies should be conducted related to the first- and last-mile problem, as transportation mode chosen by the customers has relevant effect of the environmental impact of such business models.

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